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► To cite this version:

Guillaume Barbier, Pascal Perrier, Lucie Ménard, Yohan Payan, Mark S Tiede, et al.. Speech motor control in 4-year-old children versus adults: anticipation as an index of speech motor control maturity. SMC 2017 - 7th International Conference on Speech Motor Control (SMC 2017), Jul 2017, Groningen, Netherlands. hal-01995548v2

HAL Id: hal-01995548

<https://hal.science/hal-01995548v2>

Submitted on 4 Aug 2017

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SPEECH MOTOR CONTROL IN 4-YEAR-OLD CHILDREN VERSUS ADULTS: ANTICIPATION AS AN INDEX OF SPEECH MOTOR CONTROL MATURITY

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Introduction

Learning to speak involves control of the oro-facial articulators, as well as the construction of relationships between motor commands and auditory and somatosensory sensations. The main goal of this study is to further investigate the hypothesis that differences in speech production between children and adults can be explained on the basis of speech motor control maturity. With this aim, we have designed a speech production study focused on two indices: token-to-token variability in the production of isolated vowels, and extra-syllabic anticipatory coarticulation within V1-C-V2 sequences. Token-to-token variability reflects the maturation of speech motor control in terms of motor patterns for the production of a given target speech sound. In line with theories of optimal motor control, anticipatory coarticulation is assumed to be based on the use of internal models, i.e. sensorimotor representations of speech sounds, and the amplitude of anticipatory coarticulation is presumed to reflect the increasing maturation of these sensorimotor representations as speech develops. Our hypothesis is that the neural representations of the speech motor systems of four-year-old children are immature, particularly in their inability to account for the appropriate variability compatible with correct perception of the target sound, leading to a lack of effectiveness in anticipating forthcoming gestures.

Methods and Results

Acoustic and articulatory data have been recorded using ultrasound tongue imaging, corrected for head movement with the HOCUS system. Acoustic data from 20 children and 10 adults have been analyzed. Ultrasound data have been analyzed from a subset of these participants: six children and two adults. In agreement with previous studies, token-to-token variability was greater in children than in adults. Strong anticipation of V2 in V1 realization has been found for all adults. In most cases, anticipation has not been observed in children, and when observed, it was of smaller amplitude than in adults. More specifically, only five children among the 20 studied showed a small amount of anticipation, mainly along the antero-posterior dimension.

Discussion

These results are interpreted as evidence for the immaturity of the speech motor control of children observed from two perspectives: insufficiently stable motor control patterns for vowel production, and a lack of effectiveness in anticipating forthcoming gestures. According to our theoretical framework, this lack of effective anticipation of forthcoming gestures reflects the immaturity of the neural representations of four-year-old children's speech motor systems, particularly in their inability to account for the appropriate variability compatible with correct perception of the target sound.

Further reading

Perkell, J. S. (2012). Movement Goals and Feedback and Feedforward Control Mechanisms in Speech Production. *J. Neurolinguistics*, 25(5), 382-407.

Whalen, D. H., Iskarous, K., Tiede, M. K., et al. (2005). The Haskins Optically Corrected Ultrasound System (HOCUS). *Journal of Speech, Language, and Hearing Research*, 48(3), 543-553.