Auditory–motor interactions in pediatric motor speech disorders: Neurocomputational modeling of disordered development

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Abstract

Background/Purpose

Differentiating the symptom complex due to phonological-level disorders, speech delay and pediatric motor speech disorders is a controversial issue in the field of pediatric speech and language pathology. The present study investigated the developmental interaction between neurological deficits in auditory and motor processes using computational modeling with the DIVA model.

Method

In a series of computer simulations, we investigated the effect of a motor processing deficit alone (MPD), and the effect of a motor processing deficit in combination with an auditory processing deficit (MPD + APD) on the trajectory and endpoint of speech motor development in the DIVA model.

Results

Simulation results showed that a motor programming deficit predominantly leads to deterioration on the phonological level (phonemic mappings) when auditory self-monitoring is intact, and on the systemic level (systemic mapping) if auditory self-monitoring is impaired.

Conclusions

These findings suggest a close relation between quality of auditory self-monitoring and the involvement of phonological vs. motor processes in children with pediatric motor speech disorders. It is suggested that MPD + APD might be involved in typically apraxic speech output disorders and MPD in pediatric motor speech disorders that also have a phonological component. Possibilities to verify these hypotheses using empirical data collected from human subjects are discussed.

Learning outcomes: The reader will be able to: (1) identify the difficulties in studying disordered speech motor development; (2) describe the differences in speech motor characteristics between SSD and subtype CAS; (3) describe the different types of learning that occur in the sensory–motor system during babbling and early speech acquisition; (4) identify the neural control subsystems involved in speech production; (5) describe the potential role of auditory self-monitoring in developmental speech disorders.