

Modeling the transition from competitive to coordinative control

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In early stages of development children rely predominantly on competitive control of articulation, but subsequently through the development of internal models sensory feedback, they transition to the use of coordinative control. A new phenomenological model of this transition was developed, in which selection of articulatory gestures is governed by quantized step potentials. In prototypical competitive control, gestures occupy energy levels in a mutually exclusive fashion because of strong inhibitory coupling forces. In prototypical coordinative control, multiple gestures can occupy the same energy level, due to weak inhibitory coupling. In this framework, model simulations of competitive-to-coordinative control transitions for VC and VCC syllables were conducted, with reinforcement learning of inhibitory coupling strength. Control transitions are shown to occur when inhibitory coupling strength falls below a threshold, corresponding to a reduction of the energy barrier between competitively selected gestures. An advantage of this approach is that sets of co-selected articulatory gestures do not need to be explicitly specified in the model. Hence the model exhibits greater flexibility in behavior: by tuning the strength of inhibitory coupling, both competitive and coordinative regimes of control can be simulated.