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Abstract

Predictive coding has been hypothesized as a universal principle guiding the operation in different brain areas. In this paper, a predictive coding framework for a developmental agent with perception (hearing), action (vocalization), and learning is proposed to investigate its role in speech motor skill acquisition and speech production. The agent concurrently learns to plan optimally and the associations between sensory and motor parameters, by minimizing the sensory prediction error in an unsupervised manner. Unlike existing vocal developmental models that rely on external reinforcement, the proposed agent is solely driven by sensory prediction error. The model learns initially by self-exploration and later by imitation from the ambient language. Standard vocal exploration experiments show that it learns to generate speech-like sounds (acoustic babbling followed by proto-syllables and vowels) as well as the timing for motor command execution. Random goal exploration leads to the self-organization of developmental stages of vocal sequences in the model due to increase in complexity of vocalization. The self-organization is invariant to certain acoustic feature representations. Self-

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