Running or speed-walking? Simulations of speech production at different rates

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That speakers can vary their speaking rate is evident, but how they accomplish this has hardly been studied. The effortful experience of deviating from one's preferred speaking rate might result from shifting between different regimes (system configurations) of the speech planning system. This study investigates control over speech rate through simulations of a new connectionist computational model of the cognitive process of speech production, derived from Dell, Burger and Svec’s (1997) model to fit the temporal characteristics of observed speech. We draw an analogy from human movement: the selection of walking and running gaits to achieve different movement speeds. Are the regimes of the speech production system arranged into multiple ‘gaits’ that resemble walking and running?

During training of the model, different parameter settings are identified for different speech rates, which can be conflated with the regimes of the speech production system. The parameters can be considered to be dimensions of a high-dimensional ‘regime space’, in which different regimes occupy different parts of the space.

In a single gait system, the regimes are qualitatively similar, but quantitatively different. They are arranged along a straight line through regime space. Different points along this axis correspond directly to different speaking rates. In a multiple gait system, the arrangement of the regimes is more disperse, with no obvious relationship between the regions associated with each gait.

After training, the model achieved good fits in all three speaking rates, and the parameter settings associated with each speaking rate were different. The broad arrangement of the parameter settings for the different speaking rates in regime space was non-axial, suggesting that ‘gaits’ may be present in the speech planning system.