Testing hypotheses about the underlying deficit of apraxia of speech (AOS) through computational neural modelling: Effects of noise masking on vowel production in the DIVA model

H. Terband, J. Rodd, E. Maas

A recent behavioral experiment featuring a noise masking paradigm suggests that AOS reflects a disruption of feedforward control, whereas feedback control is spared and plays a more prominent role in achieving and maintaining segmental contrasts [1]. In the present study, we set out to validate this interpretation by means of a series of computational simulations with the DIVA model [2] mimicking the behavioral experiment.

The same /bVt/ tokens were used as speech targets and in the masking condition, auditory feedback from the model's articulatory synthesizer was blocked. The modified 'AOS versions' of the DIVA model were derived from the pre-trained 'healthy speaker' model by adding random signal-independent noise to specific subsystems (feedforward commands; feedback commands; general deficit) with two levels of severity. The simulations comprised 10 trials stabilization after implementation of the deficits, followed by 10 trials with and 10 trials without auditory feedback per vowel per condition. Each simulation was repeated ten times.

Simulation results showed a larger reduction in AVS and a smaller AVD in the masking condition compared to the no-masking condition for the simulated feedforward deficit, whereas the other deficits showed an opposite pattern. These results mimic the patterns observed in the human data, corroborating the notion that AOS can be conceptualized as a deficit in feedforward control.

[1] Maas, E., Mailend, M.L. and Guenther, F.H., 2015. Feedforward and feedback control in apraxia of speech: Effects of noise masking on vowel production. JSLHR, 58(2), 185-200.

[2] Guenther, F.H., Ghosh, S.S., Tourville, J.A. 2006. Neural modeling and imaging of the cortical interactions underlying syllable production, Brain Lang, 96, 280-301.