Testing hypotheses about the underlying deficit of Apraxia of Speech (AOS) through computational neural modelling with the DIVA model

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Background: Apraxia of speech (AOS) is a neurogenic motor speech disorder resulting from brain lesions to the left cerebral hemisphere whose precise nature in terms of functional impairment is still poorly understood. A recent study featuring a noise masking paradigm [Maas, Mailend & Guenther 2015, JSLHR 58: 185-200] found that vowel spacing (acoustic contrast) was more reduced under masking noise conditions in speakers with AOS than in control speakers. Additionally, vowel dispersion (token-to-token variability) was larger in the AOS group compared to the controls in the no-masking condition, while similar in the masking noise condition.

Purpose: The pattern of these behavioural results 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. The present study set out to validate this interpretation of AOS as a feedforward impairment using computational neural modelling with the DIVA model.

Method: In a series of computational simulations with the DIVA model featuring a noise-masking paradigm mimicking the behavioural experiment, we investigated the effect of a feedforward, feedback, feedforward+feedback, and a dysarthria impairment on average vowel spacing and dispersion in the production of six /bVt/ speech targets.

Results: The simulation results indicate that the output of the model with the simulated feedforward deficit resembled the group findings for the human speakers with AOS best.

Conclusions: These results provide support to the interpretation of the human observations, corroborating the notion that AOS can be conceptualized as a deficit in feedforward control.