From abstract phonemes to speech movements: the role of orofacial biomechanics and multisensory motor goals.

Pascal Perrier[1], Jean-François Patri[1,2] & Julien Diard[2]

[1]Univ. Grenoble Alpes, CNRS, GIPSA-Lab, UMR 5216, F-38000 Grenoble, France
[2]Univ. Grenoble Alpes, CNRS, LPNC UMR 5105, F-38000 Grenoble, France

In this talk, we will present some results generated with our generic speech production model GEPPETO, that are consistent with the view that investigating physical realizations of phonological units and understanding how they emerge and evolve requires considering crucial physical properties of the speech production apparatus and key-features of speech motor control. First, using 2D and 3D biomechanical models of the tongue and the face, we will show that movement trajectories and then spectral variations that carry phonological information from the speaker to the listener can be significantly influenced by orofacial biomechanics and the variation of its dynamical behavior across speaking conditions (clarity, speaking rate). Second, using our recently developed Bayesian model of speech production planning, we will show how speech variability patterns are constrained by the nature of the motor goals, depending on whether they are auditory, somatosensory or both.

References

Perrier P., Payan Y., Zandipour M. & Perkell J. (2003) Influences of tongue biomechanics on speech movements during the production of velar stop consonants: A modeling study. *Journal of the Acoustical Society of America, 114(3)*, 1582-1599.

Buchaillard, S., Perrier, P., & Payan, Y. (2009). A biomechanical model of cardinal vowel production: muscle activations and the impact of gravity on tongue positioning. *Journal of the Acoustical Society of America*, *126(4)*, 2033-2051.

Nazari, M.A., Perrier, P., Chabanas, M., & Payan, Y. (2011). Shaping by stiffening: a modeling study for lips. *Motor control*, *15(1),* 141-168.

Patri, J.F., Diard, J., & Perrier, P. (2015). Optimal speech motor control and token-to-token variability: a Bayesian modeling approach. *Biological Cybernetics*, *109 (6),* 611–626.