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Probing the in-mouth texture perception with a biomimetic tongue

Jean-Baptiste Thomazo (Sorbonne Université/Nestlé), **Elie Wandersman** (Sorbonne Université), **Alexis Prevost** (Sorbonne Université), **Benjamin Le Révérend** (Nestlé)

Recent psychophysics based experimental investigations on both humans and rodents have revealed that the tongue-palate system of mammals possesses remarkable texture discrimination capabilities, which are not fully explained by rheological measurements. Theoretically, a possible explanation of such exquisite sensitivity proceeds from both the tongue softness and its surface topography in the form of papillae.

To explore such possibilities, we have developed a measurement system, biomimetic of the tongue-palate cavity. The artificial tongue is made of a soft transparent elastomer, whose surface is covered with papillae-like structures in the form of cylindrical asperities, and placed at the base of a rheo-optical setup. In place of the palate, we use the upper rotating geometry of the rheometer. Deflections of the top of the papillae are probed using image correlation techniques.

Using well-characterized liquids, we have shown that deformations of the papillae allow determining their viscosity, in quantitative agreement with the recently proposed theoretical model.