## Neuromechanical factors of intestinal motility

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The movements of the intestine are suitable to transport aborally its very varied contents, and this makes intestinal peristalsis a special form of locomotion over terrains with significant mechanical and chemical diversity. The enteric nervous system, embedded within the gut wall, consists in complete neutral circuits capable of organising such 'locomotion'. Such circuits comprise sensory neurons, integrative interneurons and motorneurons both excitatory and inhibitory motorneurons arranged in polarised pathways. To understand the nature of the movements of the intestine and the transport of contents along its length to establish the nature and origin of the forces operating and the relation with muscle length. The strategy we used to achieve this was to combine video recordings with high-resolution manometry. From video recording of intestinal movements in isolated segments of intestine from experimental animals we constructed spatio-temporal maps of the changes in diameter (Dmaps) and described motor patterns in isolated preparations of several experimental animals species (Costa *et al.*, 2013a). From High resolution manometry we constructed spatio-temporal maps of changes in pressure (Pmaps). This enabled us to combine these spatio-temporal maps and, from the resulting DPmaps, to extracted the evolving mechanical state of the muscle during intestinal movements. From these mechanical states we could infer the state of activity of the enteric neural circuits responsible for the movements (Costa *et al.*, 2013b). Using this method, we showed that during propulsion of a natural bolus the oral excitatory and anal inhibitory enteric pathways generate oral contractions and anal relaxations that propel the bolus (Dinning *et al.*, 2014). This confirms the original insight of Bayliss and Starling (1899) on the role of polarized neural circuits in the intestine. Propulsion thus occurs with the activation of a functional neuro-mechanical loop by the intestinal contents. This mechanism adapts the speed of propulsion to the size, shape and viscosity of the contents (Costa *et al.*, 2015). In addition to this bolus dependent propulsion, further enteric neural mechanisms generate cyclic motor complexes which can extend for significant length of intestine, both colon and small intestine in many species including humans (Kuizenga *et al.*, 2015). This cyclic motor activity involves the activation of excitatory enteric motor neurons by chains of ascending and descending excitatory interneurons that act *via* nicotinic synapses to entrain the local cyclic activity along the intestine. In the mouse intestine such cyclic motor complexes can extend the entire length of small and large intestine (see poster Keightley *et al.*, 2016). The role of these cyclic motor patterns is likely to be the timing of propulsive movements and thus their observed intermittency.

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