INTERPLAY ACTIVITY-CONNECTIVITY: DYNAMICS IN PATTERNED NEURONAL CULTURES

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The ability of a neuronal tissue to efficiently process and transmit information depends on both the intrinsic dynamical properties of the neurons and the connectivity between them. One of the few experimental systems where one can vary the connectivity of a neuronal network in a control manner are neuronal cultures [1] (Fig 1a, top). Here we show that, by combining neuronal cultures with different pattering techniques, we can control and dictate the connectivity of neuronal networks. The emerging cultures are characterized by a rich spontaneous activity, but with some dynamical traits that can be ascribed to the underlying, engineered wiring architecture. Simple patterned cultures can be obtained by plating neurons onto predefined topographical molds, which guide neurons and connections through complex paths (Fig. 1a, bottom). In contrast to homogeneous cultures, characterized by an on/off behavior where all neurons fire in a short time window (activity plot of Fig. 1b, left), patterned cultures show more complex spatio–temporal dynamics (Fig. 1b, right), and with varying propagation paths and velocities.
Patterned cultures provide a valuable tool to understand not only the interplay activity–connectivity, but also aspects such as the emergence and maintenance of spontaneous activity, synchronization, the presence of specific dynamic motifs, and even network resilience and adaptability.

[1] J.-P. Eckman *et al.*, Phys. Rep. **449**, 54-76 (2007).