Predictability and hierarchy in animal behavior

GORDON BERMAN, Emory University

Even the simplest of animals exhibit behavioral sequences with complex temporal dynamics. Prominent amongst the proposed organizing principles for these dynamics has been the idea of a hierarchy, wherein the movements an animal makes can be understood as a set of nested sub-clusters. Although this type of organization holds potential advantages in terms of motion control and neural circuitry, measurements demonstrating this for an animal's entire behavioral repertoire have been limited in scope and temporal complexity. Here, we use a recently developed unsupervised technique to discover and track the occurrence of all stereotyped behaviors performed by fruit flies moving in a shallow arena. Calculating the optimally predictive representation of the fly's future behaviors, we show that fly behavior exhibits multiple time scales and is organized into a hierarchical structure that is indicative of its underlying behavioral programs and its changing internal states.