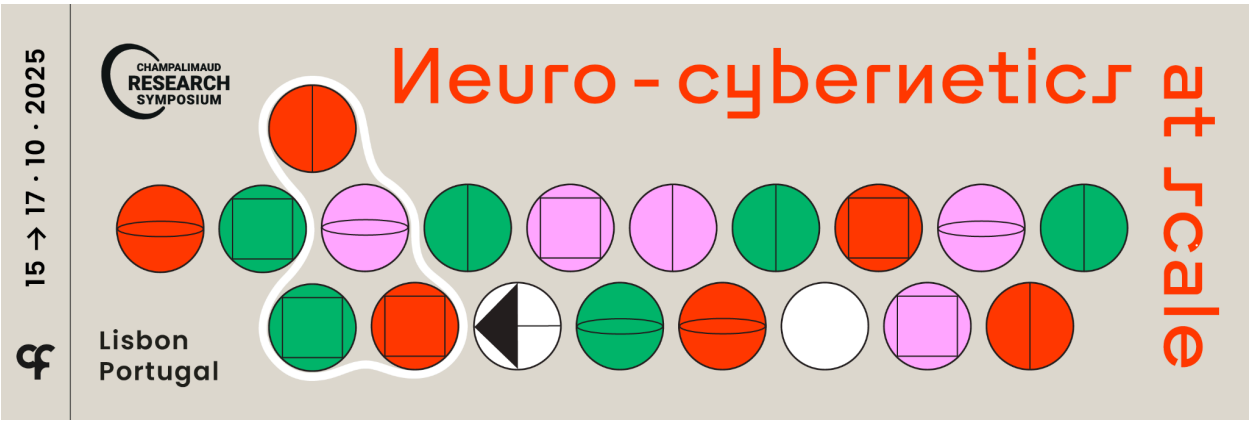

Decoding individuality in the micro-structure of mouse behavior

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Individuality is an intrinsic and essential aspect of animal behavior that emerges even in genetically identical organisms experiencing the same environmental conditions [1]. In the International Brain Laboratory (IBL), over one hundred mice were trained on a visual decision-making task with the explicit goal of establishing a rigorously standardized experimental protocol. This effort led to an automated pipeline that produced proficient mice whose behavior was indistinguishable across seven different labs, when considering trial-level descriptors of behavior [2]. Nevertheless, substantial inter-individual variability was evident in both training time and proficient behavior [2,3], but its nature remains poorly characterized. To address this, we developed a semi-supervised modular segmentation approach to characterize the fine-grained temporal structure across multiple behavioral variables (e.g. wheel movement, whisking and licking). This yielded a discrete latent space of syllables which we further analyzed at different timescales. Variability in the expression of behavioral syllables was highly structured revealing systematic differences across mice, which allowed individual identity to be decoded. Importantly, behavioral signatures were stable across sessions for most mice, indicative of different strategy types or even mouse personality traits. Furthermore, the micro-behavioral structure identified during proficient behavior after training predicted the learning speed of individual mice across training. This ability to retrospectively relate micro-behavioral structure from the proficient phase to the learning phase is indicative of long-term stability and suggestive of meaningful differences in behavioral idiosyncrasies that impact learning trajectories or systematic variation in adaptive cognitive strategies.

Mouse behavior, behavioral variability, individuality, Hidden Markov Models