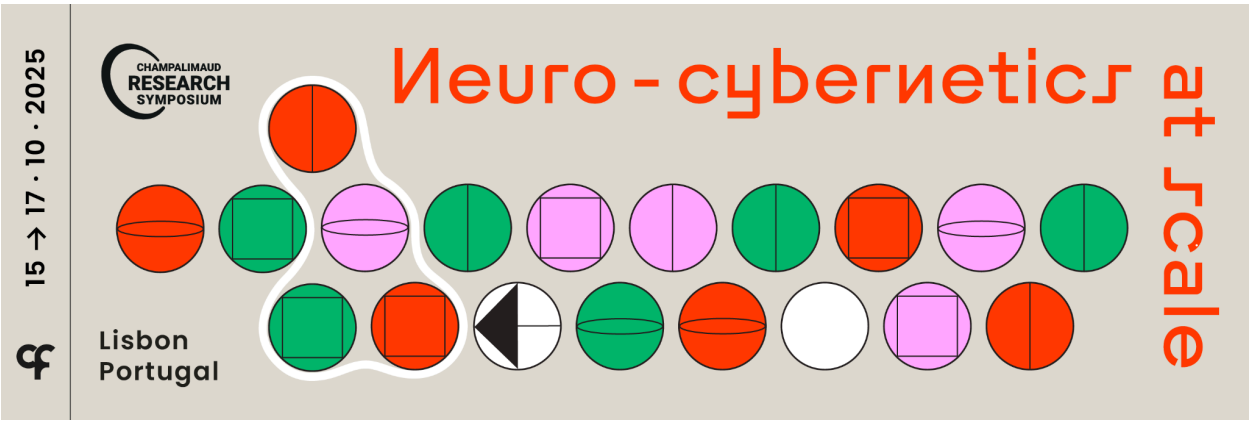

Comparing the activity of four neuromodulators during decision-making

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The four principal neuromodulators (NMs) - dopamine (DA), serotonin (5-HT), norepinephrine (NE), and acetylcholine (ACh) - are implicated in decision-making processes such as reward prediction errors, learning, and uncertainty, yet the unique contributions and mechanisms by which they interactively shape decision-making remain unclear since most studies target individual NMs in varying paradigms, preventing direct comparisons.
To address this, we leveraged the International Brain Laboratory (IBL) framework, using a highly standardized, reproducible decision-making task. We employed fiber photometry to record bulk calcium activity of genetically targeted NM populations expressing GCaMP6f across ~750,000 trials in ~40 double-transgenic mice during learning and proficient stages of a visually guided decision-making task.
Consistent with prior research, DA activity increased after rewards and decreased after errors, with graded amplitude changes depending on the trial difficulty, reflecting reward prediction errors. In contrast, 5-HT exhibited strong responses to incorrect choices - suggesting an unsigned prediction error signal, and also showed suppression before stimulus onset, potentially linked to maintaining task focus. NE signals were notably variable across and within mice, pointing to possible specialized roles in different subpopulations. ACh activity was higher in early training stages, especially during correct trials, indicating a role in learning processes.
Together, these findings highlight distinct and complementary roles for each NM in encoding reward-related contingencies that may guide future behavior. Integrating fiber photometry data with IBL's behavioral and electrophysiological datasets offers a powerful platform to dissect how these neuromodulatory systems interact during learning and decision-making.

neuromodulators, decision making, behavior, dopamine, serotonin