The noradrenergic system, which is the cholinergic, dopaminergic, and noradrenergic systems regulate attention in distinct, but complementary ways. ACh projections from the substantia innominata / nucleus basalis region (SI/nBM) to the neocortex are necessary to increase attention to relevant stimuli [1]. ACh projections from the medial septum / vertical limb of the diagonal band (MS/VDB) to the hippocampus and medial frontal cortex are crucial to reduce attention to irrelevant stimuli [2]. The noradrenergic system, which is driven by activity in the locus coeruleus (LC), is thought to shift attention when facing uncertainty and novelty in an environment [3].

We developed a neural simulation to provide insight into how ACh can decrement or increment attention using two distinct pathways, and how dopamine and noradrenaline influence these pathways.

**Experimental Setup**

**Neural Architecture**

**Neural and Synaptic Dynamics**

Firing rate neuron model: $s(t) = \alpha s(t) - \beta s(t - 1) + \gamma e^{\text{sigmoid}(\delta)}$

Input: $I(t) = \sum_j a_{ij} r_j(t) \quad \text{Nm MS: } m_{ij}^{\text{RM}}(t + 1) = K c^{\text{RM}}(t)$

$\text{Nm LC & SI: } m_{ij}^{\text{RM}}(t + 1) = \alpha e^{\text{sigmoid}(\delta)} + \beta e^{\text{sigmoid}(\delta)}$.

Plasticity: Hebb: $\Delta m_{ij}^{\text{RM}}(t) = r_{ij}(t) r_{ij}(t - 1)$

Depres. $\Delta m_{ij}^{\text{RM}}(t) = r_{ij}(t) r_{ij}(t - 1)$

Nm VTA: $m_{ij}^{\text{RM}}(t + 1) = m_{ij}^{\text{RM}}(t)$

$\Delta m_{ij}^{\text{RM}}(t) = r_{ij}(t) r_{ij}(t - 1)$

**RESULTS**

**Latent Inhibition and Persisting Behavior**

1. Test position learning
   - LEFT = reward criterion
   - No reward criterion
   - 5000 time-steps criterion

2. Test latent inhibition
   - LEFT = reward criterion
   - No reward criterion
   - 5000 time-steps criterion

3. Test persisting behavior
   - LEFT = reward criterion
   - No reward criterion
   - 5000 time-steps criterion

**CONCLUSIONS**

We developed a behavioral paradigm that dissociates decremental and incremental attention. The model exhibits latent inhibition, persisting behavior, habituation to stimuli, and increased learning when facing novel or unexpected stimuli and reward associations. lesioning the MS disrupts latent inhibition, and increases drastically perseverative behavior. lesioning the SI disrupts increments in conditioned stimulus processing. lesioning the LC results in difficulty learning novel reward associations.


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