**A homeostatic mechanism for subitizing in number perception**

Animals have been shown to possess an Approximate Number System, which they use to estimate quantity-related information relevant to survival. For example, insects, such as bees, require numerical discrimination to determine whether the object they are targeting can be classified as food or not [1]. An important function of such a system is subitizing, which is the ability of agents to perceive the number of objects in the environment as a group without counting them. Importantly, this skill suggests an analogy between spatial skills and mathematical skills, where the location on the number line is represented internally in the brain [2]. In this seminar, I will present a biologically plausible model of subitizing that frames it as a homeostatic mechanism that align environmental inputs with internal space-like representations. The first part of the model uses homeostasis as a form of magnitude comparison along the number line. Here, we define the homeostasis as a negative feedback control system [3], where the agent minimizes its internal belief of its location on the number line against the external sensory input. Subitizing can then be thought of as an equilibrium point of a self-regulatory process.

The second part of our model propose a neuronal representation of the number line based on attractor dynamics. This representation, an attractor network, can be seen as a spatial one, in which, the position in the number line is encoded by a bump of activation in the network. Indeed, there is evidence that regions of the brain related to spatial cognition, such as the hippocampus, show number related activations that are topologically equivalent to our model [4].

Finally, we propose the process of aligning external inputs with internal representation as a neural implementation of the Active Inference [5]. We consider the homeostatic mechanism as a form of free-energy minimization and how the agent acts on the attractor network is considered as a form of internal action taken by the agent to minimize the difference in their beliefs.

**[1]** [**https://doi.org/10.1098/rstb.2016.0513**](https://doi.org/10.1098/rstb.2016.0513)

**[2]** [**https://doi.org/10.1016/j.cedpsych.2018.10.007**](https://doi.org/10.1016/j.cedpsych.2018.10.007)

**[3]** [**https://doi.org/10.1152/japplphysiol.01064.2005**](https://doi.org/10.1152/japplphysiol.01064.2005)

**[4]** [**https://doio.org/10.1038/s41562-023-01709-3**](https://doi.org/10.1038/s41562-023-01709-3)

**[5] https://doi.org/10.1007/s10539-022-09864-z**