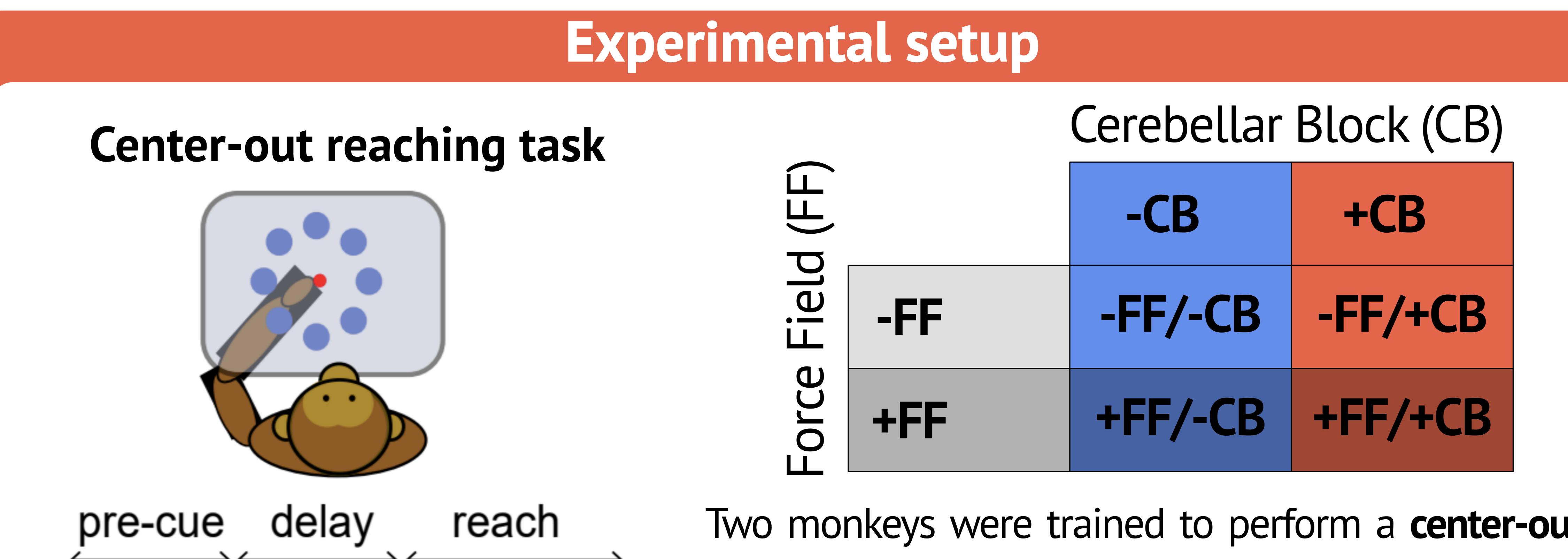
Cerebellum Shapes the Preparatory Dynamics of Motor Cortical Neurons in Force Field Adaptation

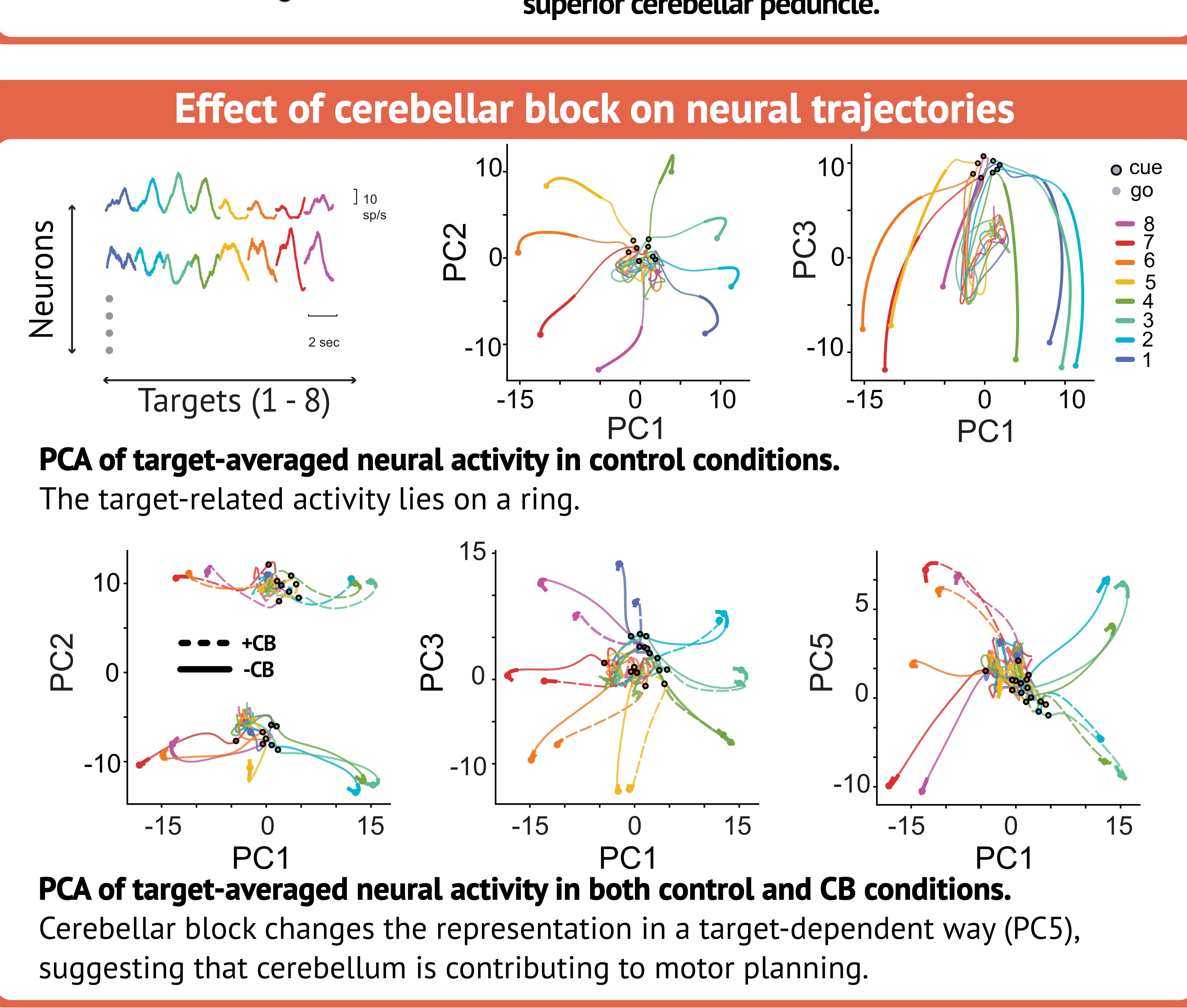
Hugo Ninou¹, Sharon Israeli², Lee Elmaleh², Firas Mawase³, Yifat Prut², Jonathan Kadmon²

1 Ecole normale supérieure - PSL, France 2 Edmond and Lily Safra Center for Brain Sciences, Hebrew University of Jerusalem, Israel 3 Faculty of Biomedical Engineering, Technion - Israel Institute of Technology, Israel

Motivation: In vertebrates, the cortico-cerebellar loop plays a crucial role in motor adaptation, yet it is unknown how the cortex and cerebellum interact during this process. In particular, it is unclear whether the cerebellum only performs feedback control, adjusting movement during execution, or if it also shapes preparatory activity.

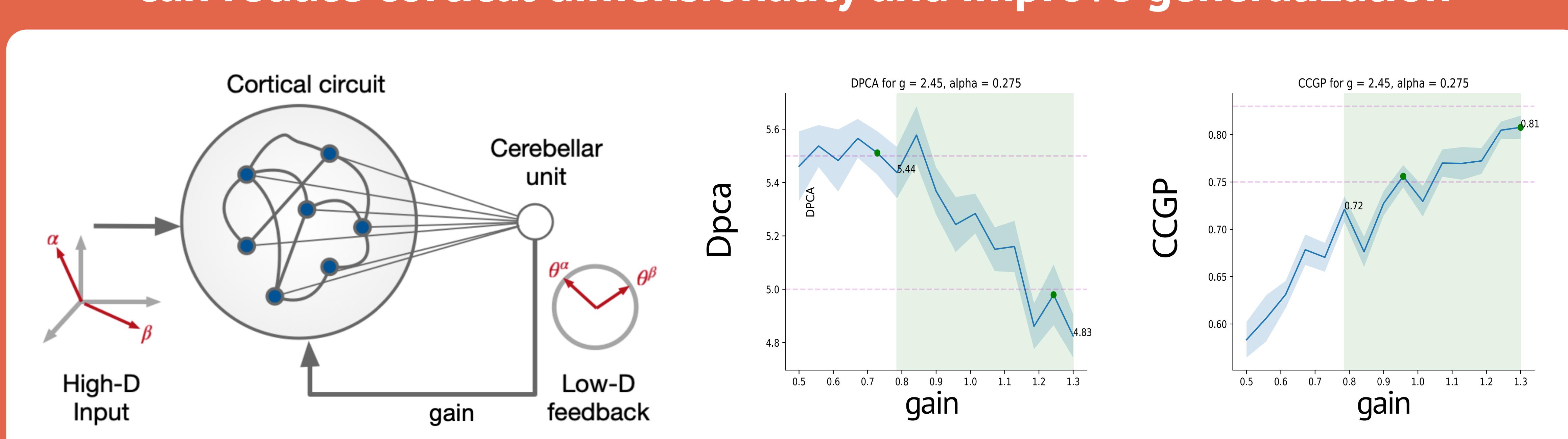


Two monkeys were trained to perform a **center-out reaching task**, while neural activity was recorded in **premotor** and **motor cortices**. Cerebellar block was achieved via **high frequency stimulation** [1] of the **superior cerebellar peduncle**.



Corohollar block increases the dimensionality of preparatory states

A simple computational model confirms that a low-dimensional feedback can reduce cortical dimensionality and improve generalization

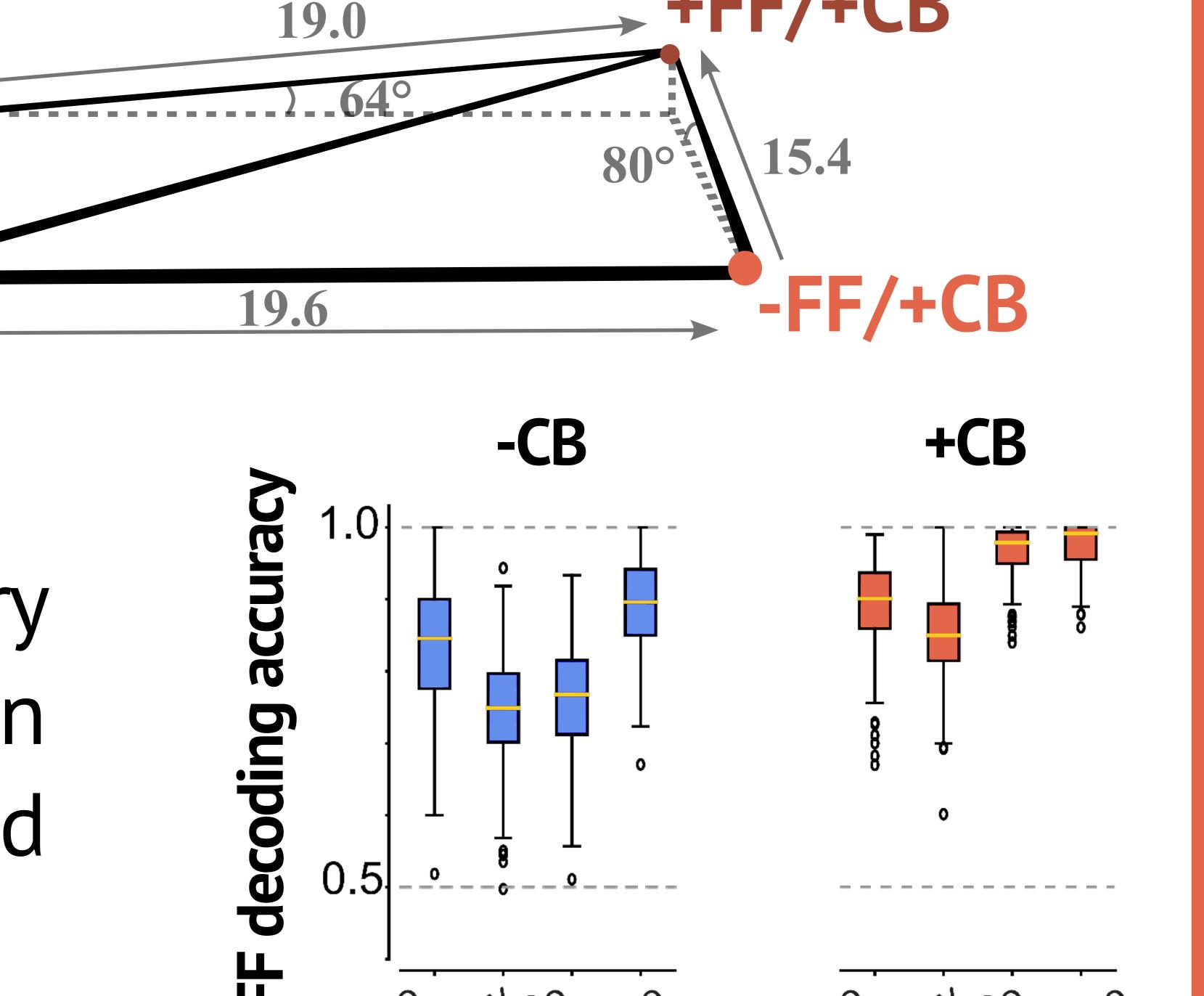


We trained a recurrent neural network that received a **high-dimensional input** indicating a target, to represent its location on a 2D ring. The output was fed back into the cortical circuit via random weights, mimicking a simplified cortico-cerebellar loop.

Weakening the structured feedback results in increased dimensionality and reduced CCGP in the activity, supporting the role of the cerebellum as providing target-related feedback.

Cerebellar Block and Force Field have non-additive effects on the motor plan Preparation Preparation HFF/+CB HFF/-CB 13.3 HFF/-CB 15.2 HFF/-CB 15.4

The separation between FF and Null Field preparatory activities increased during CB, but this separation did not lie in the plane spanned by the two vectors (-FF/-CB; +FF/-CB) and (-FF/-CB; -FF/+CB).



Changes in the target plane drive residual adaptation under cerebellar block

LEE / CD CW