Neuro-computational modelling of value construction

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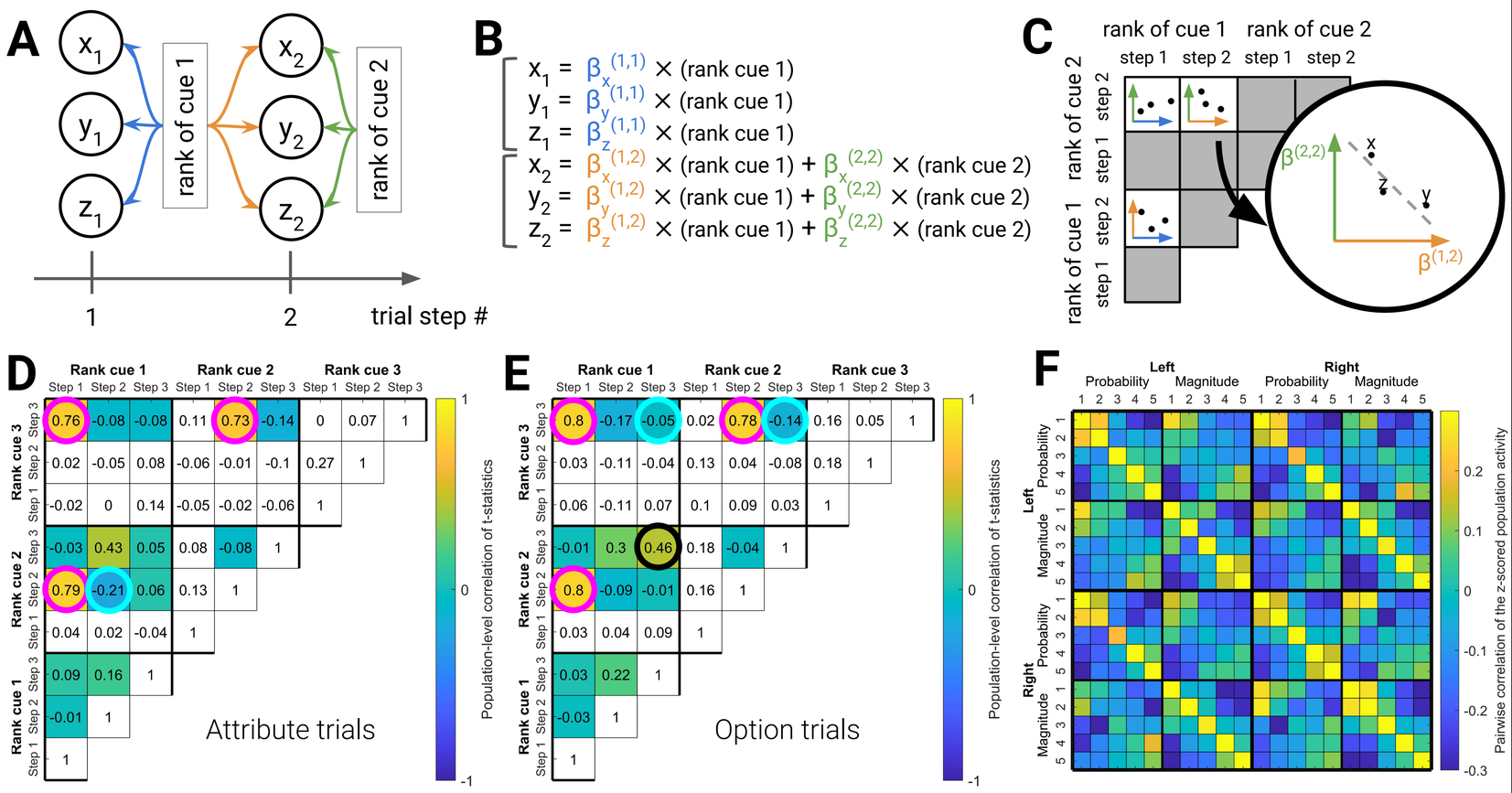
Abstract

We trained artificial neural networks to solve different computational problems for value-based decision-making, using several frameworks of value construction. By comparing their representational geometry against electrophysiological recordings in the orbitofrontal cortex made available by Hunt et al. (2018), we showed that scenarii of value construction, value comparison and option choice could all explain the key representational geometry features observed in the OFC.

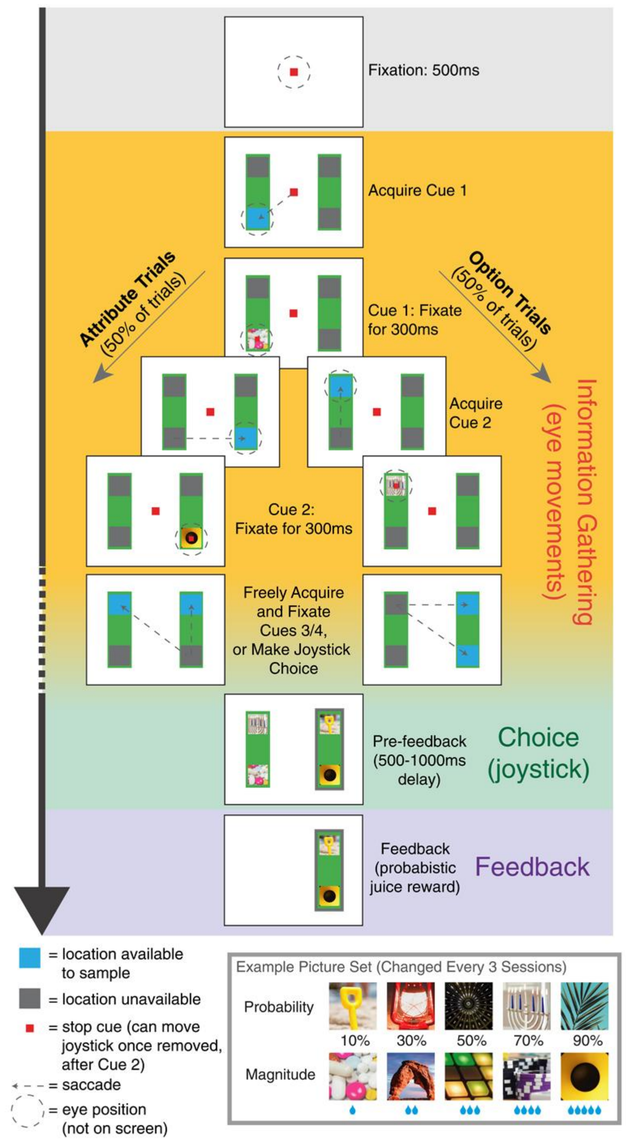


2. Key representational geometry features in the OFC - from Hunt et al. (2018)

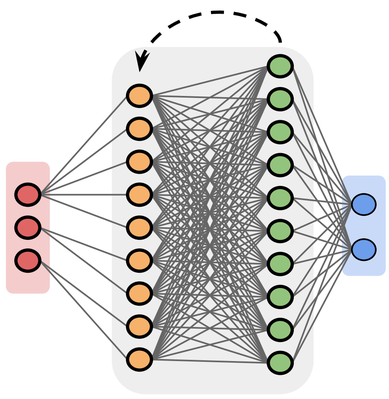
D-E) Stable encoding of the rank of the attended cue throughout a trial (pink circles)
D-E) Relative encoding of option values (cyan circles)
D-E) Building option value from attribute integration (black circle)
F) Stimulus identity encoding and value encoding
These could be signatures of **value comparison** in the OFC.

1. Experimental data

Single-unit electrophysiological recordings were gathered by Hunt et al. (2018) in the **dorsolateral prefrontal cortex**, the **orbitofrontal cortex** and the **anterior cingulate cortex** of two macaque monkeys during a binary decision task.



3. Training artificial neural networks

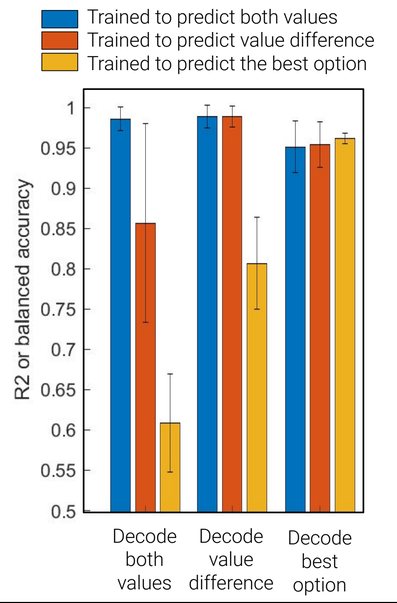


We train ANNs, by varying…
The computational problem they solve:
- Value construction
- Value comparison
- Option choice

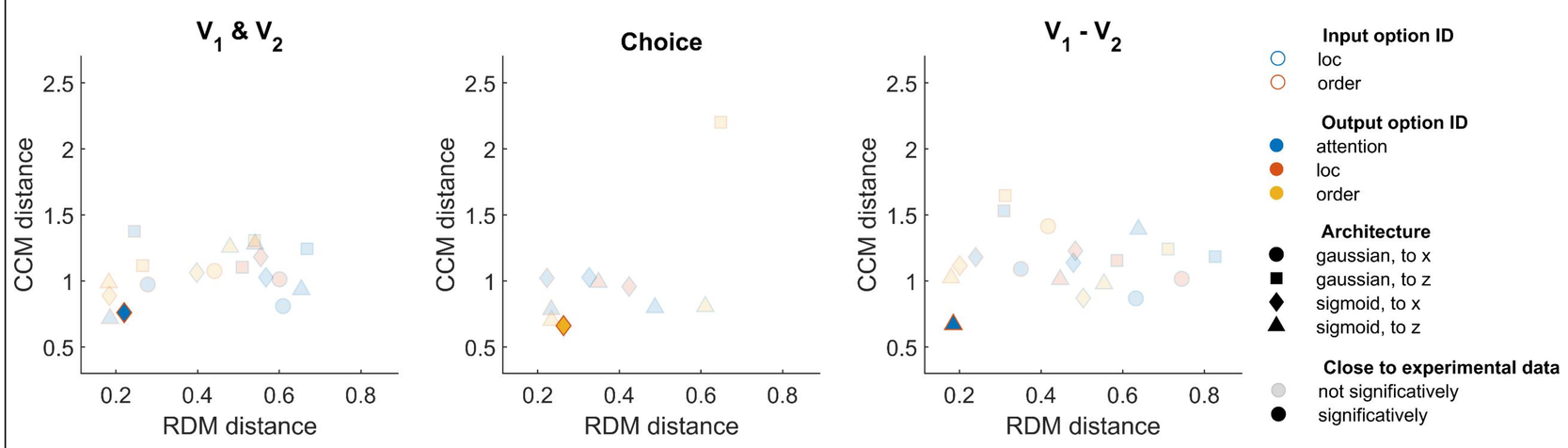
→There is a loss of information between different transformations.

Which framework they use in input and output:
- Left vs. right option
- Attended vs. unattended option
- First option of the trial vs. the other one

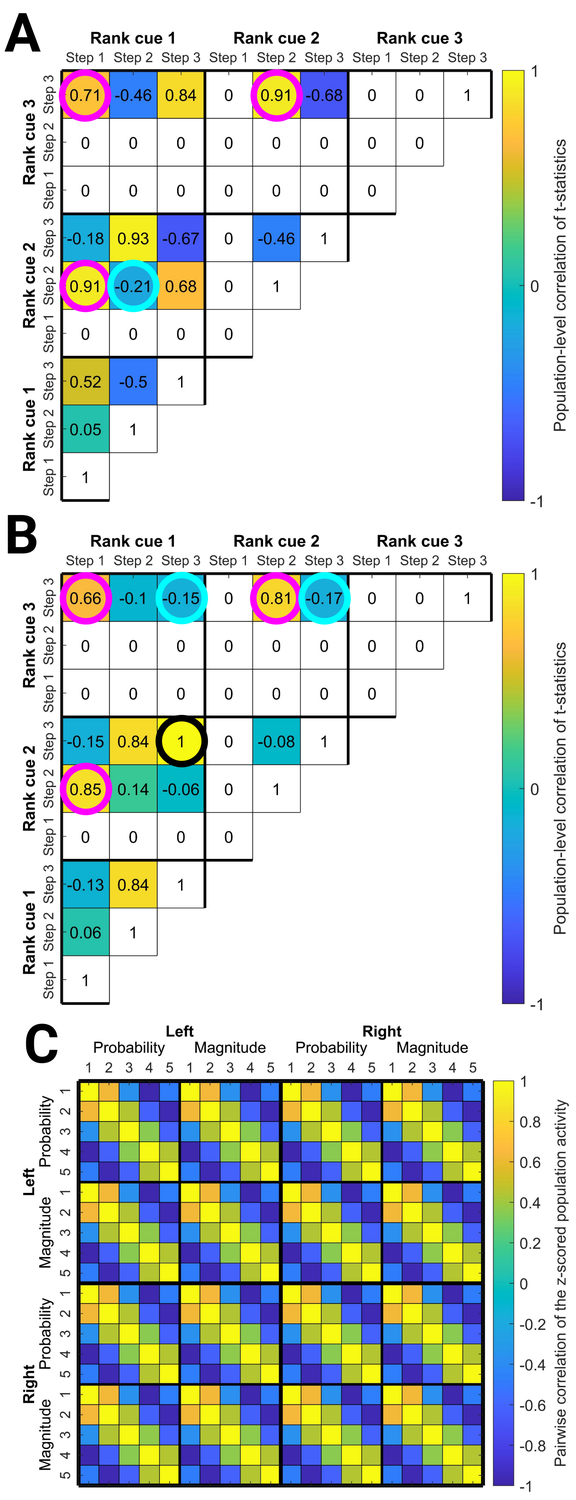
Their architecture:
- Recurrent connection to the first or the second layer
- Sigmoid or gaussian activation function



4. ANNs trained on various scenarii achieve close neural distance with the OFC



5. Value construction scenarii can explain the representational geometry features observed in the OFC



6. Perspectives

Adding biological constraints
- matching behaviour instead of normative transformations
- energetic budget, adaptive coding
- developmental constraints

Investigating other functions involved in value-based decision-making
- control allocation
- retrospective evaluation