Top-down signal from prefrontal cortex in executive control of memory retrieval


Presented by
Itamar Kahn
Introduction

• The prefrontal cortex exerts *executive control* on the inferior temporal cortex in memory retrieval

• Inferior temporal cortex is associated with visual long-term memory storage
Objective

Find neuronal correlates of executive control processes in inferior temporal neurons following partial and full callosal lesions.
Study Design
Methods

- Animal preparation and electrophysiology
  - Two male monkeys (*Macaca fuscata*)
  - Extracellular discharges of single neurons were recorded

- Task procedure
  - 25 Fourier descriptors sorted into 5 categories
  - Many-to-one stimulus-stimulus association task (4-to-1)
Fourier descriptors

<table>
<thead>
<tr>
<th>Category</th>
<th>CUE</th>
<th>CHOICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td><img src="image1" alt="CUE" /></td>
<td><img src="image2" alt="CHOICE" /></td>
</tr>
<tr>
<td>II</td>
<td><img src="image3" alt="CUE" /></td>
<td><img src="image4" alt="CHOICE" /></td>
</tr>
<tr>
<td>III</td>
<td><img src="image5" alt="CUE" /></td>
<td><img src="image6" alt="CHOICE" /></td>
</tr>
<tr>
<td>IV</td>
<td><img src="image7" alt="CUE" /></td>
<td><img src="image8" alt="CHOICE" /></td>
</tr>
<tr>
<td>V</td>
<td><img src="image9" alt="CUE" /></td>
<td><img src="image10" alt="CHOICE" /></td>
</tr>
</tbody>
</table>
Results

Neuronal activity in top-down condition
Results

Neuronal activity in top-down condition
Commissurotomy effect on neuronal activity and behavioral performance
Delay activity of IT neurons in top-down condition
Delay activity of IT neurons in top-down condition (cont.)

Temporal dynamics of response correlation

Correlation coefficient
delay vs. choice

Percentage of cells

Correlation coefficient
vs. choice

Correlation coefficient
vs. cue
Conclusions

• Inferior temporal neurons were activated by top-down signal in the absence of bottom-up sensory inputs

• A longer onset latency was observed for the top-down signal
  – Can be attributed to signal transformation in the prefrontal cortex
  – However, is could also be that the late onset is due to weaker inputs that need to accumulate to reach threshold

• Top-down signal triggered development of prospective information encoding the choice image to be recalled
Implications

• Prefrontal signal contributes to visual associative memory retrieval

• Behavioral relevance of the signal

• Explore possible interpretations
  – Bottom-up signal through route different from the one ablated
  – Top-down signal directly serving memory retrieval by dynamically creating an internal representation of the world in the posterior association cortex
Thank you