Motivation

• Multivariate analysis of fMRI data allows for decoding category representations (Multivoxel Pattern Analysis, MVPA) and item representations (Representational Similarity Analysis, RSA)\(^1\).
• Designs optimized for univariate analysis may not be appropriate for multivariate analysis.
  - Slow event-related designs suitable for all analyses but limit the number of trials.
  - Rapid event-related designs with large number of jittered trials are standard for univariate, condition-based analyses\(^2\) but likely unsuitable for trial-specific estimates.

How are item and category estimates across the brain affected by trial timing during a memory task?

Experimental design

Study (in fMRI scanner)

- 12 stimuli/run (6 tools + 6 animals)
- 2-4 repetitions each

Design

<table>
<thead>
<tr>
<th>Design</th>
<th>Rep #</th>
<th>ITI (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quick (4@4-8s)</td>
<td>4</td>
<td>4 or 8</td>
</tr>
<tr>
<td>Quick (4@6s)</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Med (3@8s)</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Slow (2@12s)</td>
<td>2</td>
<td>12</td>
</tr>
</tbody>
</table>

Multivariate analysis

Category decoding via MVPA

- Train (Run 1)
  - Animal Tool
  - Trial model
  - Stimulus model
- Predict (Run 2)

Item decoding via RSA

Run 1 Run 2

- Item representation:
  - Hippocampus (hip)
  - Parahippocampal cortex (pfc)
  - Inferior frontal gyrus (ifg)
  - Inferior parietal cortex (ipar)
  - Superior parietal cortex (supar)

Regions of interest

Trial model

Category decoding (MVPA)

- Quick (4@4-8s)
- Quick (4@6s)
- Med (3@8s)
- Slow (2@12s)

Item decoding (RSA)

- Item representation (Cohen\'s d)

- Greater item representation in slow designs.

Item decoding (RSA): Remembered vs. Forgotten items

- Fiber\'s transformed Pearson correlation

Behavioral results

- Test score

Stimulus model results similar

- Category decoding: fixed length quick and medium timing still outperform improved jittered design.
- Item representation: slow design advantage, although less pronounced
- Memory tracking remains better in slower designs.

Conclusions

- Category decoding best in faster designs with fixed trial length.
- Item representations more reliable in slow designs than rapid designs.
- Better memory tracking in slower designs.
- Jittered quick design underperformed other designs in both category and item representations.

References