Human MTL neurons can parse a set of abstract symbols

NN8

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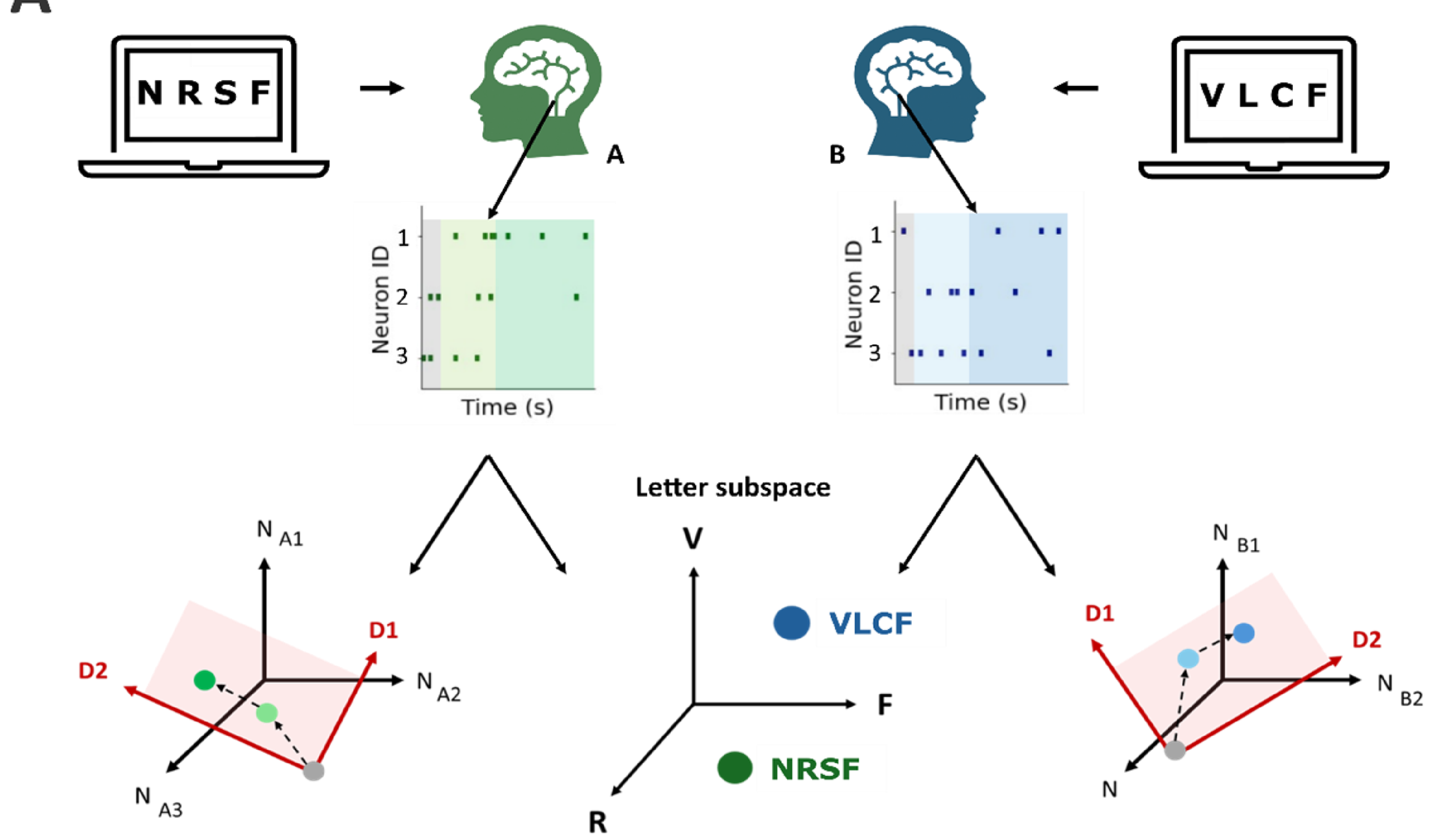
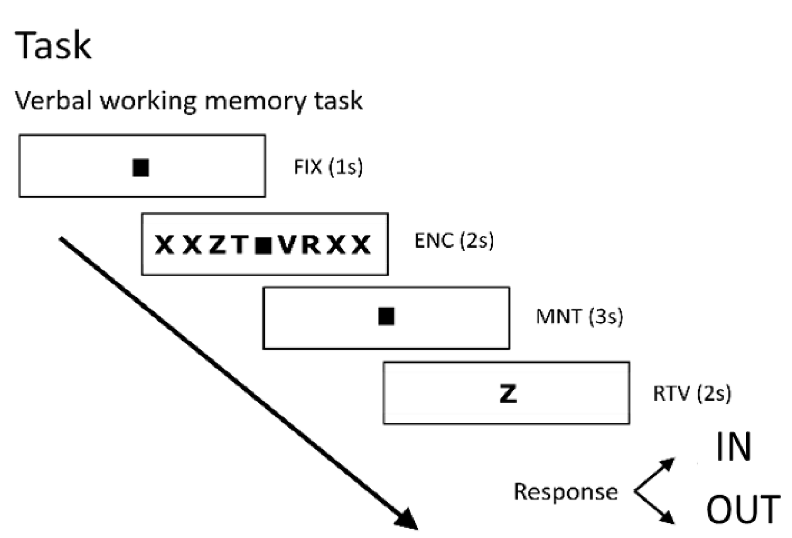
Introduction

The medial temporal lobe (MTL) is involved in human working memory (WM). We recorded single-neuron activity from the MTL of 9 epilepsy patients performing a WM task with visually presented letter strings. The presented abstract symbols make long-term memory recollection unlikely. We show that populations of human MTL neurons can parse sets of letters into single letter representations.

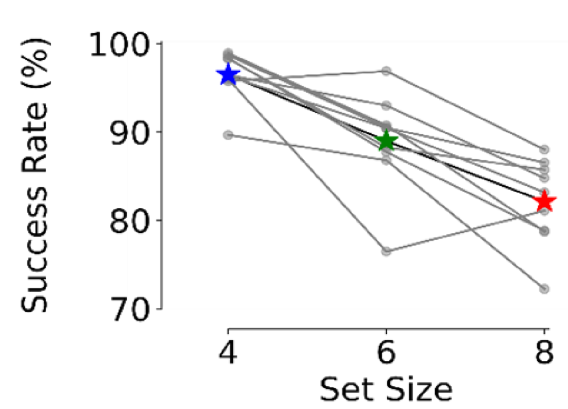
A



B



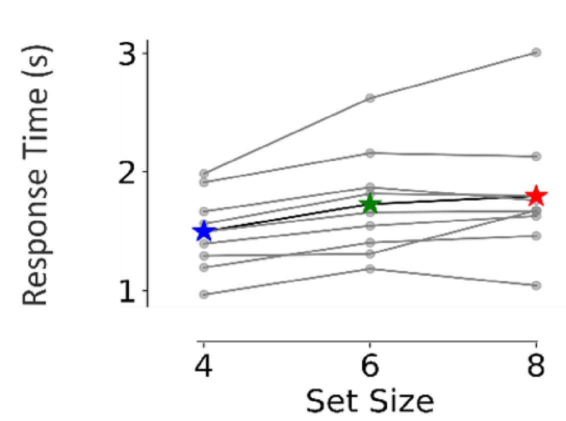
D



C

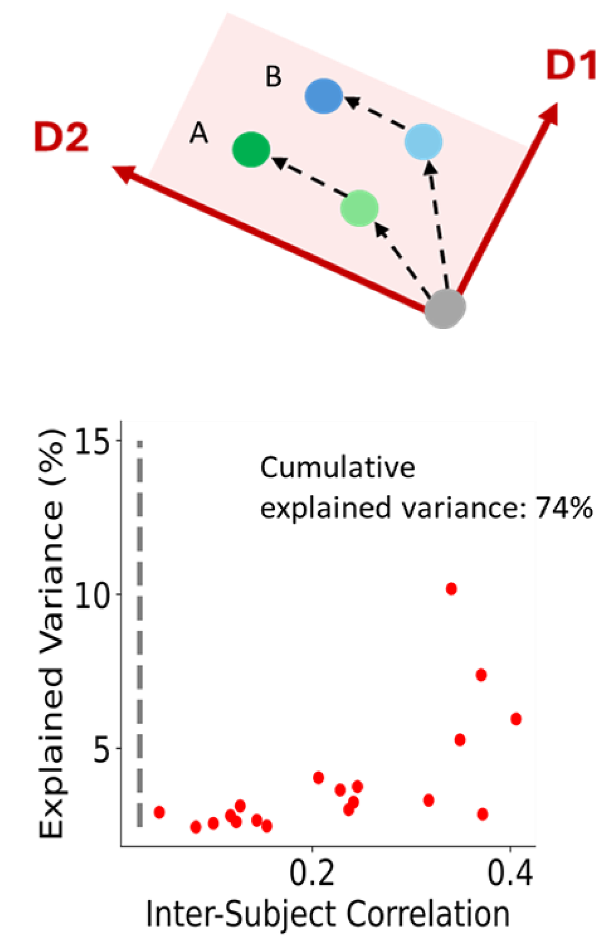
Area	Neurons	
HIP	719	62%
AMY	278	24%
ENT	166	14%
	1163	

E



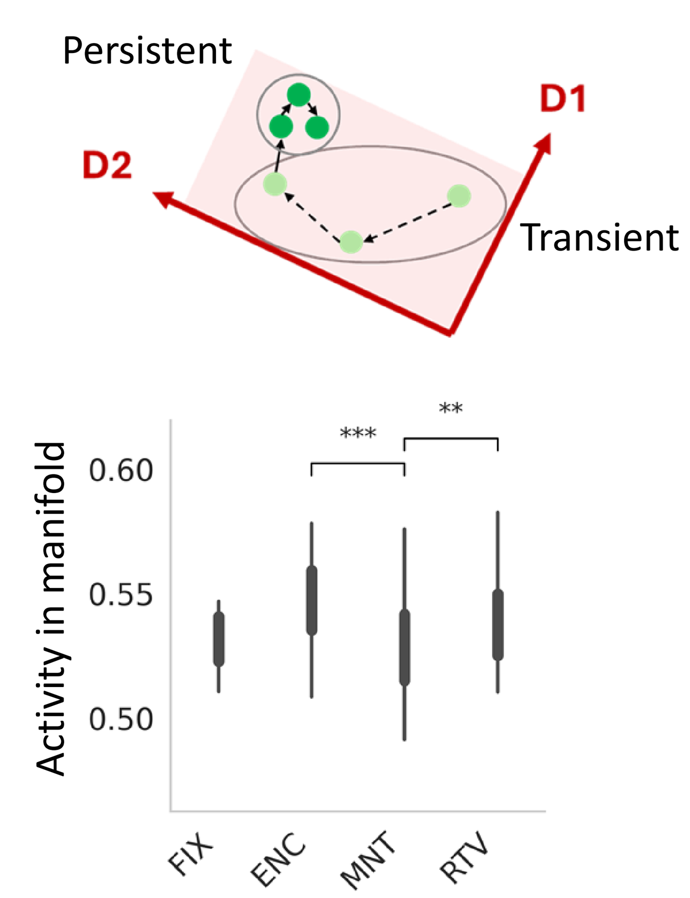
D. The rate of correct responses decreases with set size ($p < 0.0001$).
E. Response latency increases with set size ($p = 0.0001$).

1. Neural firing covaries across participants



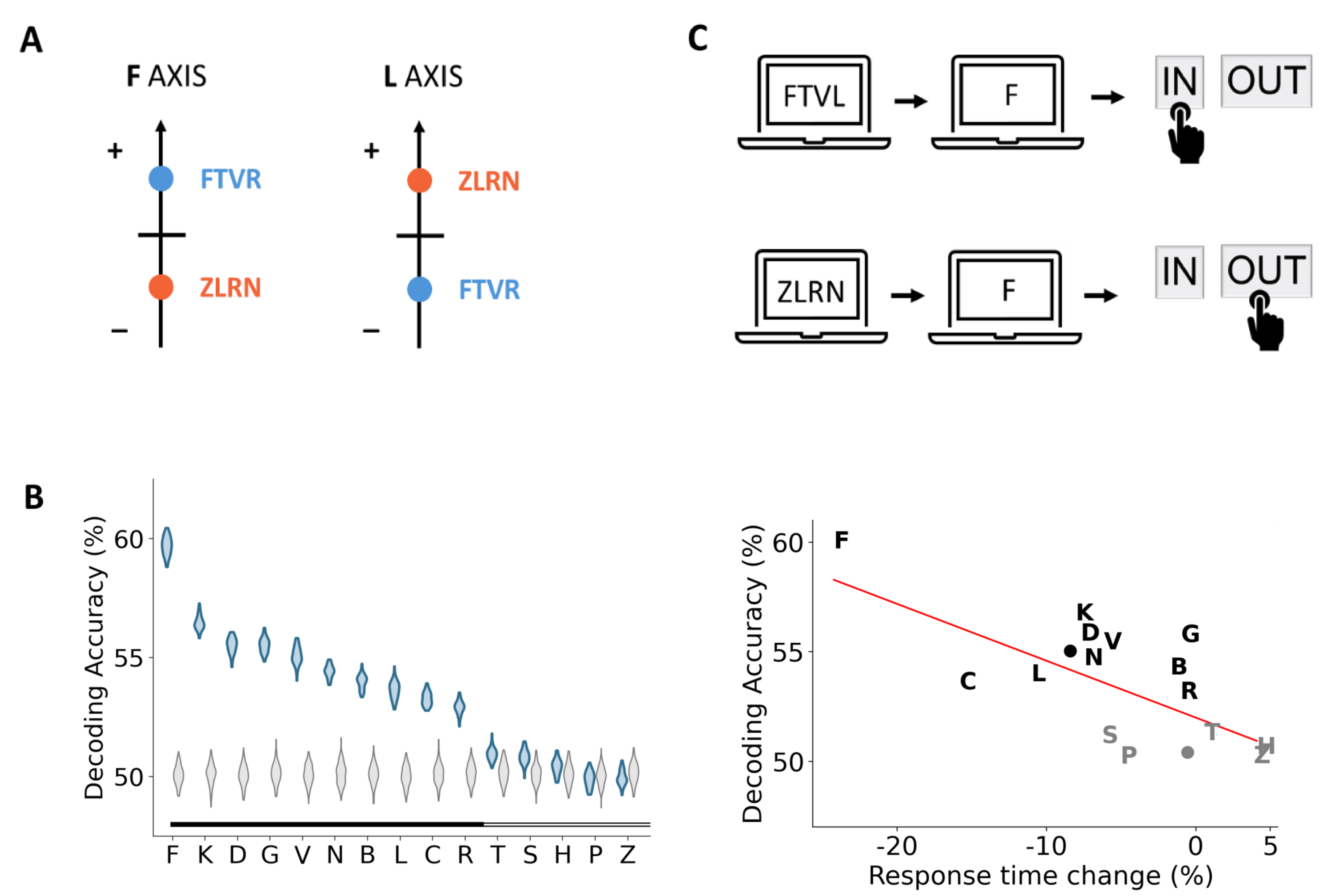
We aligned neural activity from all subjects into a low-dimensional manifold with significant inter-subject correlation (cumulative explained variance of 74%).

2. Manifold describes trial stage



Encoding and retrieval show transient neural states. Maintenance is associated with a more persistent representation.

3. Decodable letters elicit fast responses



A. We test whether single letters can be decoded ("F" present *vs.* "F" absent).

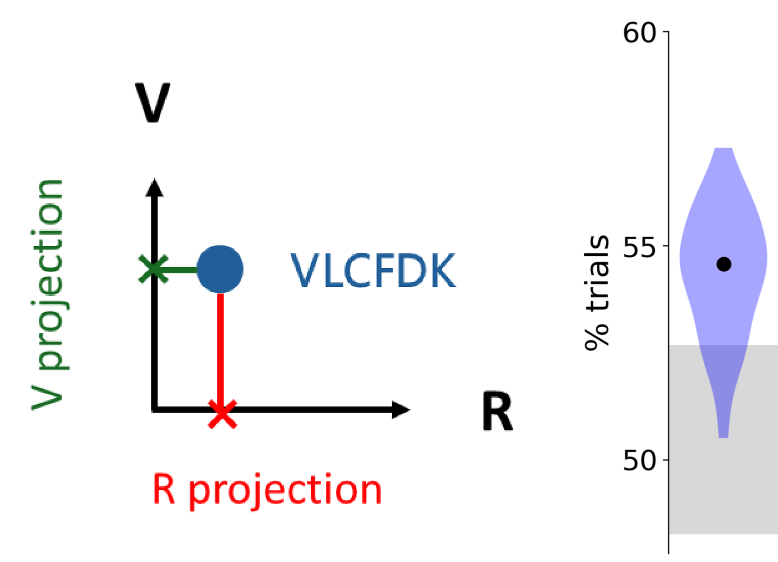
B. Decoding accuracy is significant for 10 out of the 15 presented letters ($p < 0.005$).

C. Over all letters, participants tend to respond faster for IN trials than for OUT trials (r_{IN} = 1.57 ± 0.37 s , r_{OUT} = 1.78 ± 0.51 s).

D. Higher decoding accuracy correlates with faster response time.
Spearman correlation: -0.58, p = 0.02
Response time change ($\frac{r_{IN}-r_{OUT}}{r_{OUT}}$)

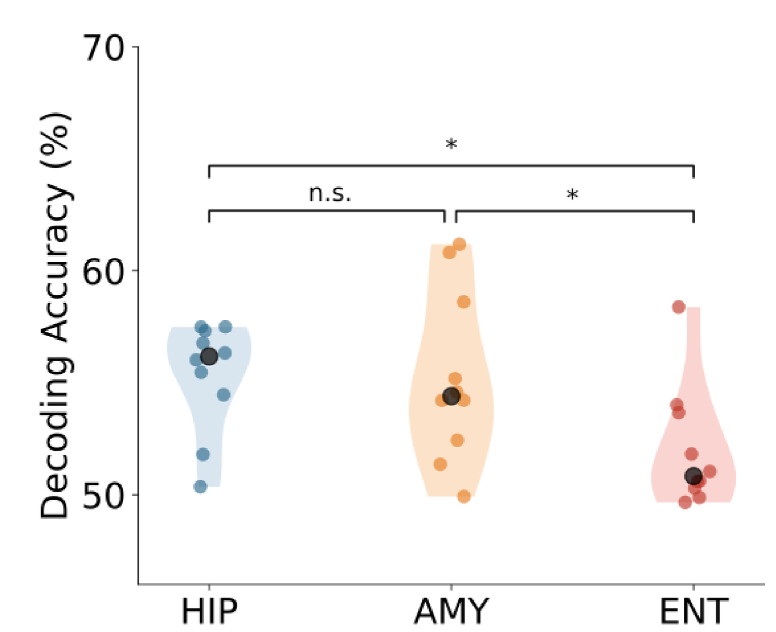
Letters with **significant decoding** elicit faster responses compared to letters with **non- significant decoding** ($p = 0.028$).

4. Letter strings can be parsed



We test whether we can retrieve the letter content at the single trial level. The projection for present letters is higher than the projection for absent letters for the majority of trials (blue violin).

5. Both hippocampus and amygdala support encoding



Decoding accuracy in AMY (24% of neurons) is comparably high to decoding accuracy in HIP (62% of neurons).

Conclusions

- MTL neurons can parse single letters in a letter string.
- Higher letter decoding accuracy correlates with faster response time.
- Response time depends on set size and stimulus familiarity.

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