Trial timing in fMRI designs for pattern information analyses

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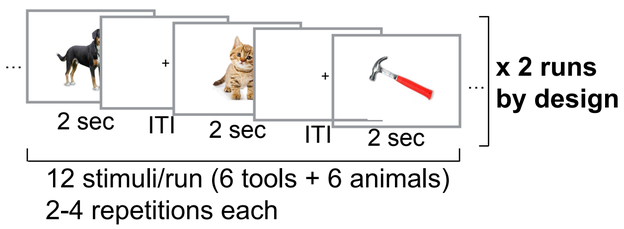
Motivation

- Multivariate analysis of fMRI data allows for decoding category representations (Multivoxel Pattern Analysis, MVPA) and item representations (Representational Similarity Analysis, RSA)[1,2].
- 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[3] but likely unsuitable for trial-specific estimates.

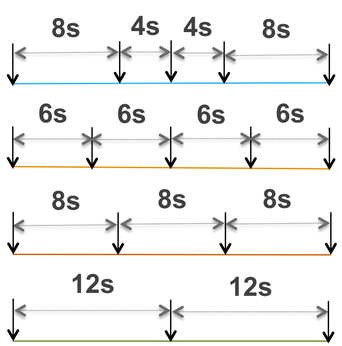
How are item and category estimates across the brain affected by trial timing during a memory task?

Experimental design

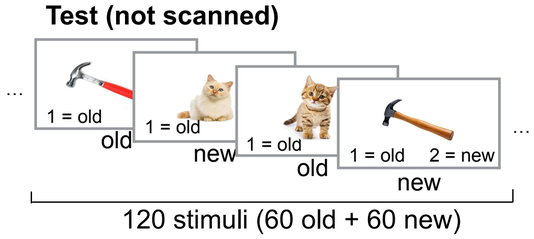
Study (in fMRI scanner)



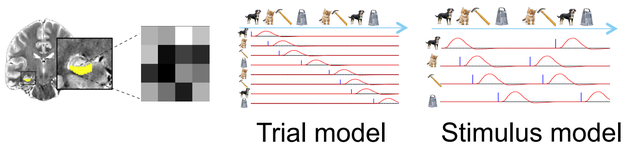
Design	Rep #	ITI (sec)
Quick (4@4-8s)	4	4 or 8
Quick (4@6s)	4	6
Med (3@8s)	3	8
Slow (2@12s)	2	12



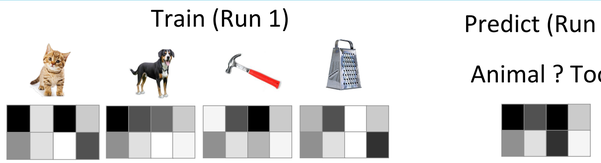
Test (not scanned)



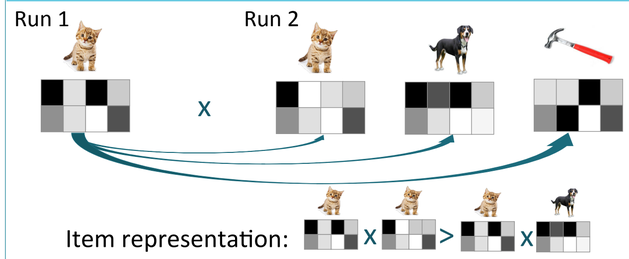
Multivariate analysis



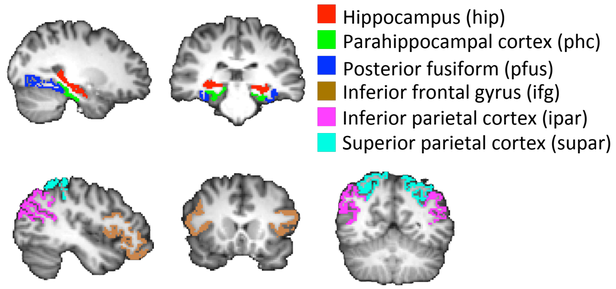
Category decoding via MVPA



Item decoding via RSA

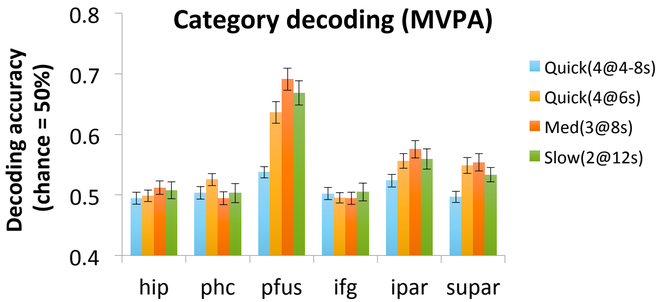


Regions of interest

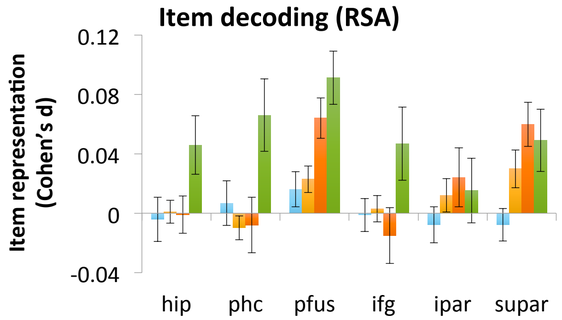


Results

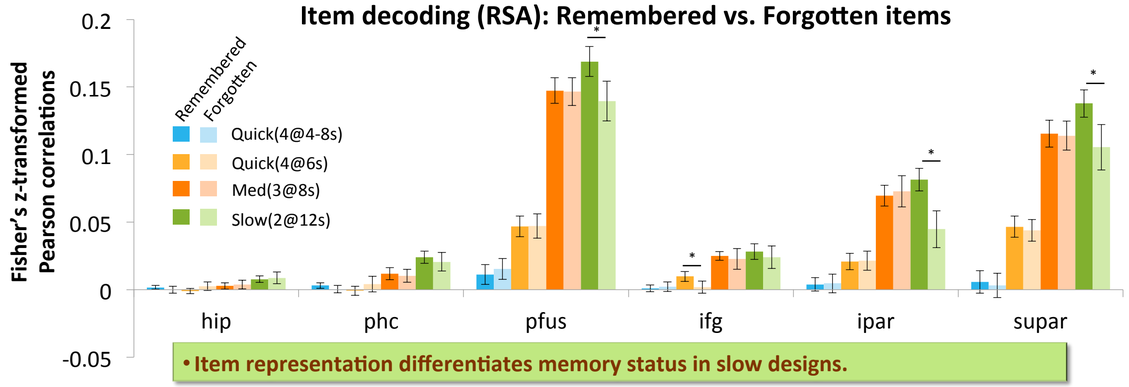
Trial model



- Category decoding benefits from more repetitions in faster designs but is harmed by jitter.

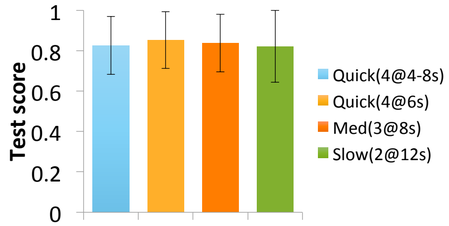


- Greater item representation in slow designs.



- Item representation differentiates memory status in slow designs.

Behavioral results



- Test scores equivalent across designs.

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

1. Norman, K.A., Polyn, S.M., Detre, G.J., and Haxby, J.V. (2006). Beyond mindreading: multi-voxel pattern analysis of fMRI data. *Trends Cogn. Sci. (Regul. Ed.)* 10, 424–430.
2. Kriegeskorte, N., Mur, M., and Bandettini, P. A. (2008). Representational similarity analysis-connecting the branches of system neuroscience. *Frontiers in systems neuroscience*, 2, 4.
3. Dale, A. M. (1999) Optimal experimental design for event-related fMRI. *Hum. Brain Mapping*, 8:109 –114.