# Rapid adaptation impacts the encoding and decoding of natural stimuli

Lan Luo, Lindsey L. Glickfeld

Department of Neurobiology, Duke University, Durham, NC
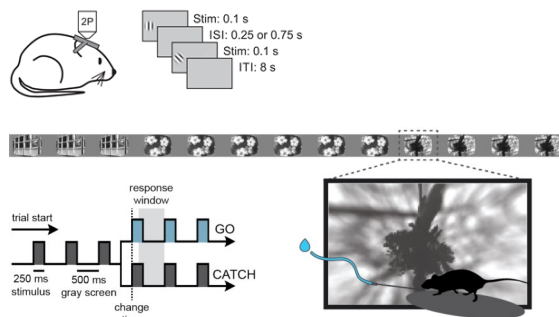
Background

- Adaptation alters visual processing in response to input history
- ⟹ suppression of neural response to repeated or prolonged presentation of a stimulus
- amplified in ventral visual pathway (V1 → lateromedial area LM → laterointermediate area LI), whose downstream encodes object identity
- causes neural representation to be biased away from that of frequently encountered stimuli (adapter)
- ⟹ proposed to reduce redundancy in population activities and increase coding efficiency
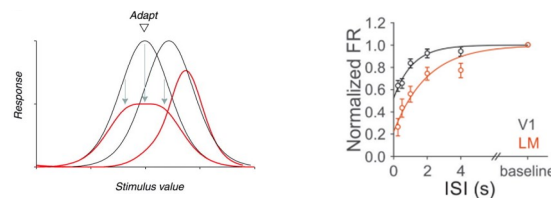
- ? Question: How does visual adaptation transform the encoding and affect decoding of stimuli identity in a realistic setting - at rapid timescales, with naturalistic visual input, and across stages of visual processing?
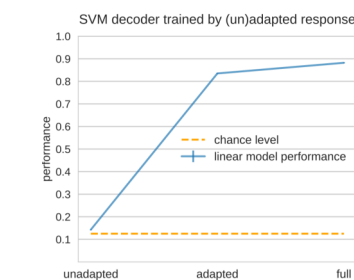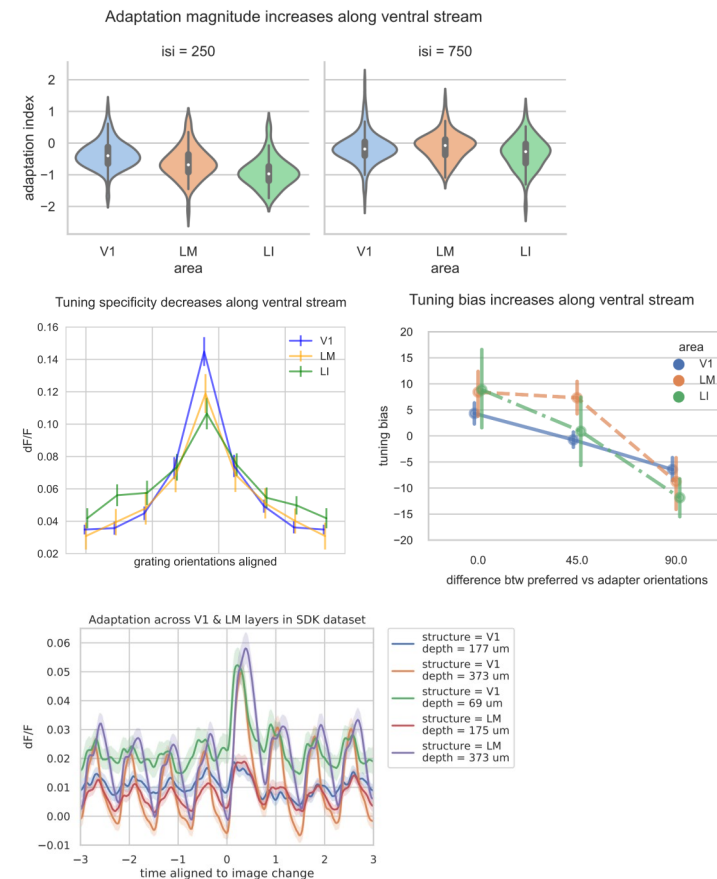
Methods

- present to mice stationary gratings or natural images
- two-photon calcium imaging recording from V1, LM, and LI
- leverage Allen Institute visual behavior open source dataset

passive viewing
untrained images
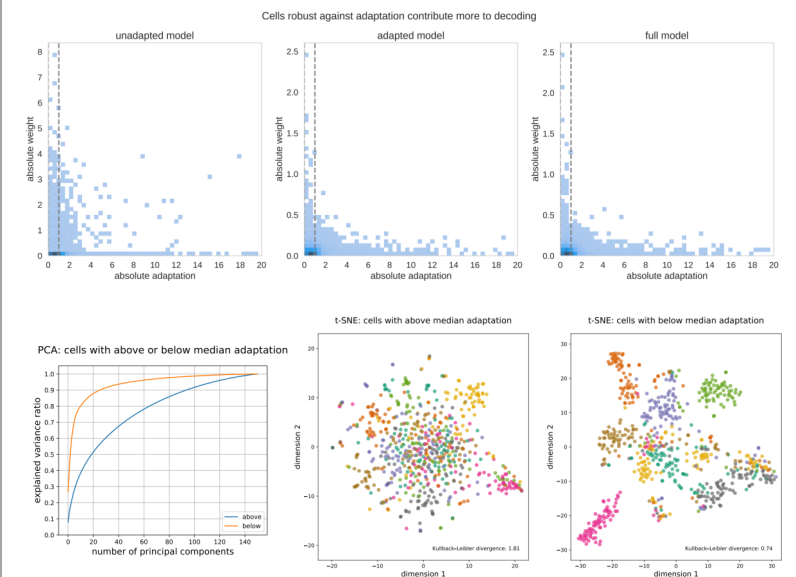excitatory neuron
V1 & LM
layer 1, 2/3, 3, 4

Results

Adaptation magnitude increases along ventral stream

Tuning specificity decreases along ventral stream

Tuning bias increases along ventral stream

Adaptation across V1 & LM layers in SDK dataset

SVM decoder trained by (un)adapted response

[there should be a lineplot overlaid on the left plot:

the performance of nonlinear decoder (fully connected neural net) on (un)adapted and full dataset]

Results

Cells robust against adaptation contribute more to decoding

PCA: cells with above or below median adaptation

t-SNE: cells with above median adaptation

t-SNE: cells with below median adaptation

Conclusions

- Rapid adaptation is magnified along mice ventral stream (V1-LM-LI) , resulting in an increasing repulsive tuning bias away from adapter
- Neural representation post adaptation is more linearly decodable, possibly due to less adapted neurons encoding natural images in a lower dimensional space

Future Directions
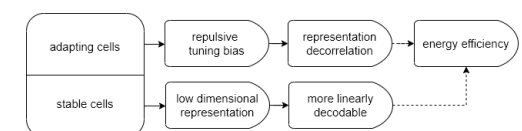
Reference

Kohn et al. 2007
Jin et al. 2019
Allen Brain Observatory: Visual Behavior 2P Technical Whitepaper