

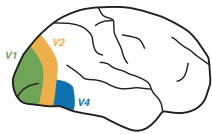


hierarchical representation of naturalistic texture in cortex

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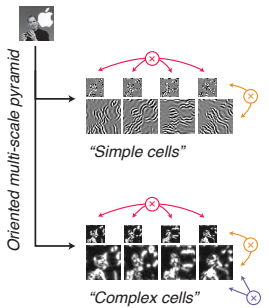
1 introduction

- Cortical processing of complex visual stimuli is hierarchical
- Natural textures are well characterized by a hierarchical statistical model (Portilla & Simoncelli, 2000)
- Images appear to be composed of the same texture if they match with respect to a small collection of image statistics

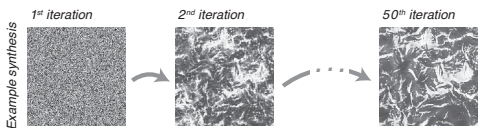


Do extra-striate visual areas encode the higher-order statistics that distinguish natural textures?

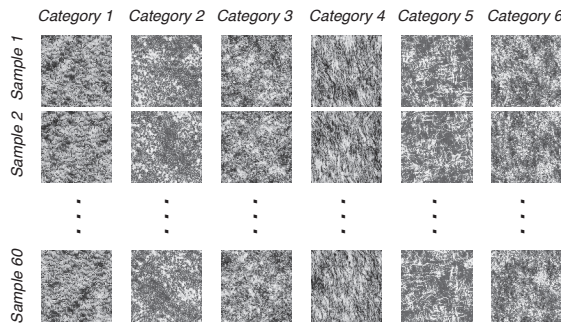
2 texture model



- Statistics**
- Total energy in each channel
 - Correlations across
 - orientation
 - scale
 - position
- Synthesis**
- Start with Gaussian white noise
 - Iteratively impose statistics using gradient descent

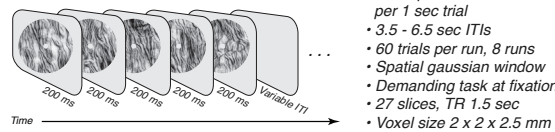


3 texture stimuli



- Matched power spectra (averaged over orientation)
- Matched mean luminance and contrast
- 60 texture samples per category

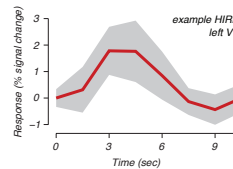
4 procedure



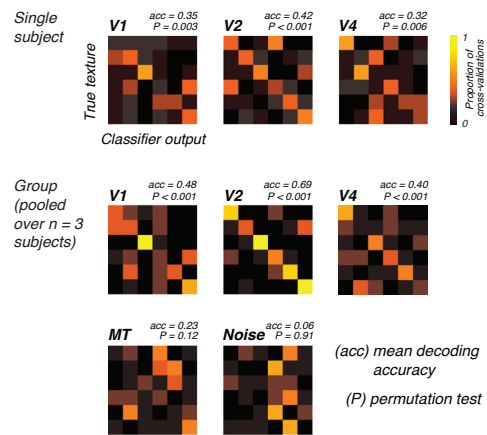
- 5 samples of texture per 1 sec trial
- 3.5 - 6.5 sec ITIs
- 60 trials per run, 8 runs
- Spatial gaussian window
- Demanding task at fixation
- 27 slices, TR 1.5 sec
- Voxel size 2 x 2 x 2.5 mm

5 classification analysis

- Deconvolution to estimate hemodynamic impulse response function (HIRF) for each visual area
- Regression to estimate response amplitude for each voxel and texture category
- Six-way, maximum-likelihood, linear classifier
- Leave-one-run-out cross-validation
- Permutation (randomization) statistical tests

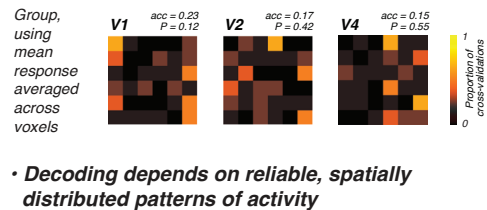


6 classification results



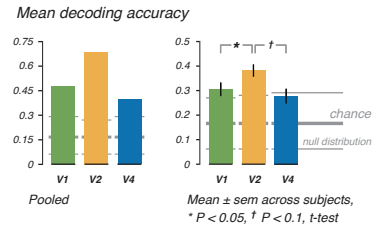
- fMRI responses in visual cortical areas reliably classify natural textures categories

7 decoding not driven by mean responses

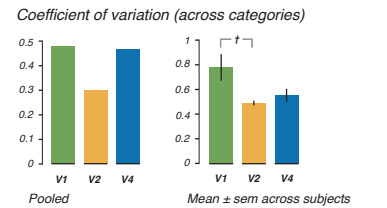


- Decoding depends on reliable, spatially distributed patterns of activity

8 compare areas



- Decoding accuracy in V2 is higher than in V1 or V4



- Variability in accuracy in V2 is lower than in V1 or V4

9 conclusions

- Texture samples from a given natural texture category produce a reliable, distributed pattern of fMRI responses in visual cortex
- As measured by fMRI response decoding, neural representation in V2 reflects image statistics that distinguish natural textures