Contrast inversion reveals hierarchical asymmetries of contrast processing in biological & artificial vision

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Contrast pathways beyond ON/OFF? Neuropixels recordings along the ventral stream

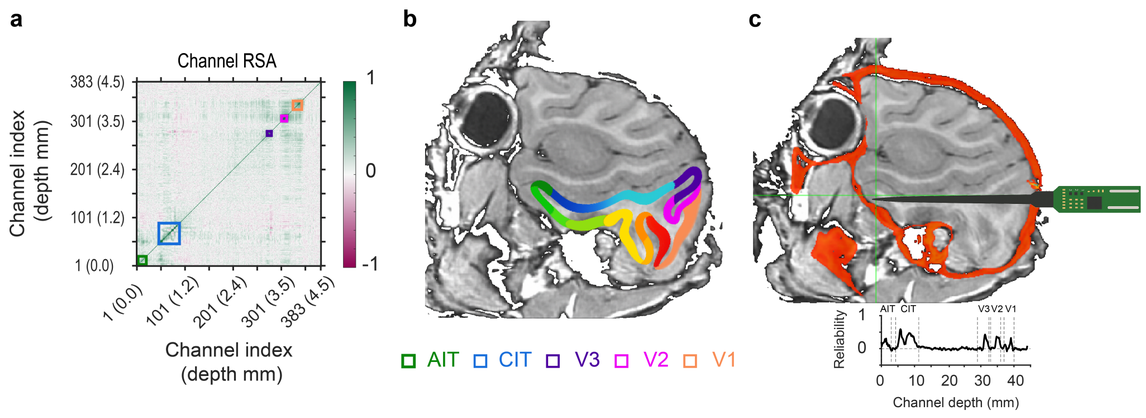

Figure 1. **a.** Channel-wise RSA analysis shown for all channels. **b.** Anatomical MRI of the monkey overlaid with an atlas of cortical areas, each displayed using a distinct colormap. **c.** Alignment of the CT scan with the anatomical MRI, with the reconstructed electrode trajectory along the superior temporal sulcus (STS). Below, the reliability values of channels plotted as a function of depth along the probe.

Contrast inversion reveals an asymmetry between primate visual cortex and CNNs

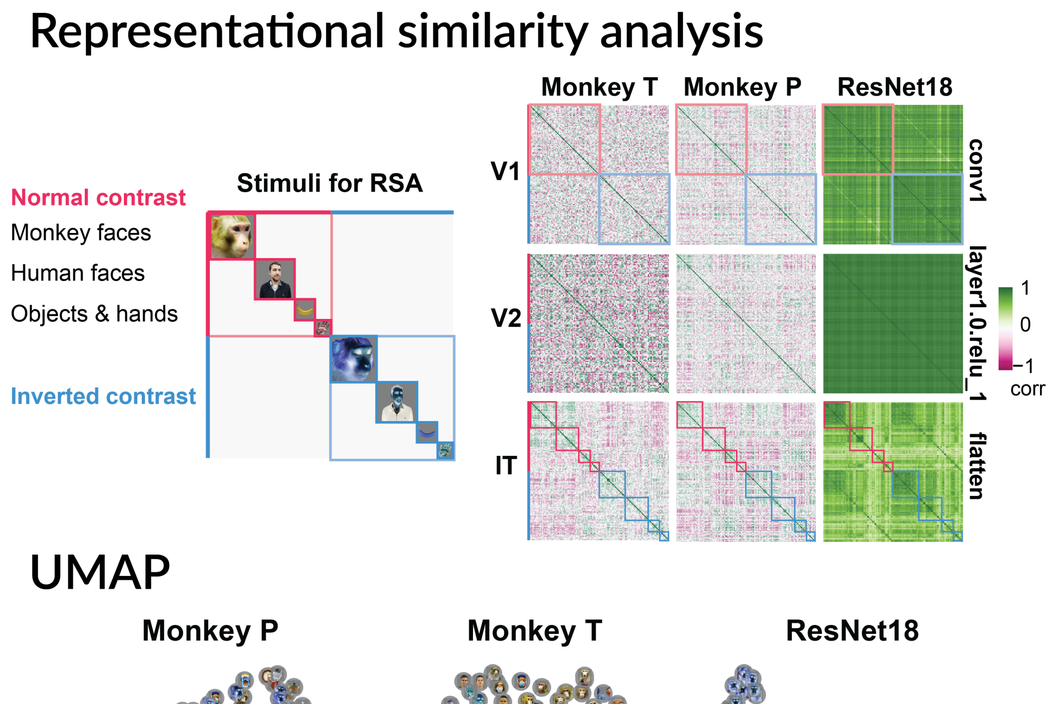

Figure 2. **a.** First layer filters in CNNs have an OFF bias. **b.** Examples of positive, natural (top, red) and inverted contrast images (bottom, blue). **c.** Mean population responses per contrast polarity from ventral stream areas V1, V2, V3, and IT in monkey T.

Gaze behavior shifts upon contrast inversion

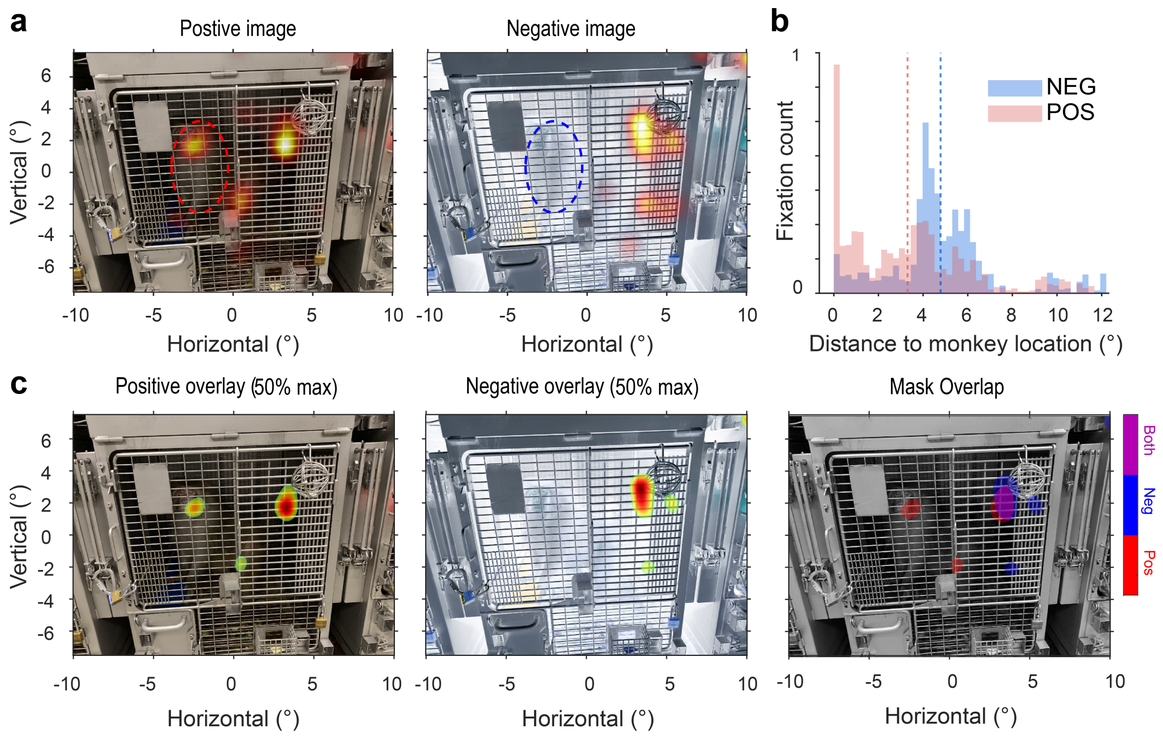

Figure 3. **a.** Saliency maps of monkey gaze during free viewing of normal and inverted contrast images. Dotted ovals indicate monkey location in photo **b.** Monkeys prefer to look at normal than inverted contrast monkeys. **c.** Gaze patterns overlap minimally across contrast polarities.

Contrast processing differs hierarchically between CNNs and visual cortex

Decoding contrast polarity across the hierarchy of visual systems.

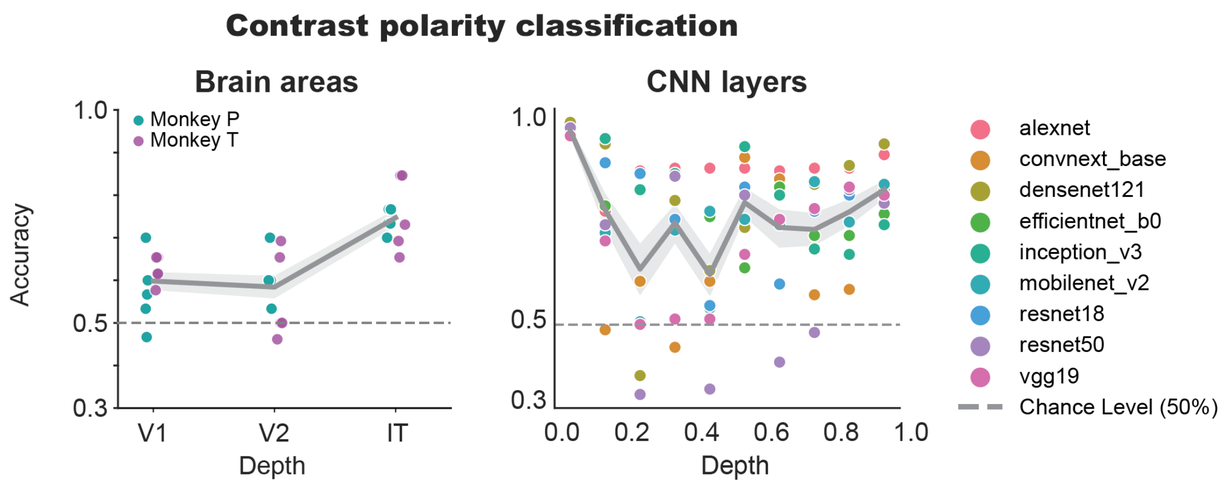

Figure 4. Linear SVM binary classification accuracy for contrast polarity in V1, V2, and IT, and in selected CNN layers.

Conclusions

Single NHP Neuropixels samples the ventral stream.

Animals gaze behavior changes with contrast inversion.

Contrast encoding follows different hierarchies in primate brains and CNNs.

Training under different contrast distributions results in similar first layer filters but different high-level representations.

Funding Alice and Joseph Brooks Fellowship and Hearst Fellowship (G.R.T.)

Training distribution alters late but not early representations

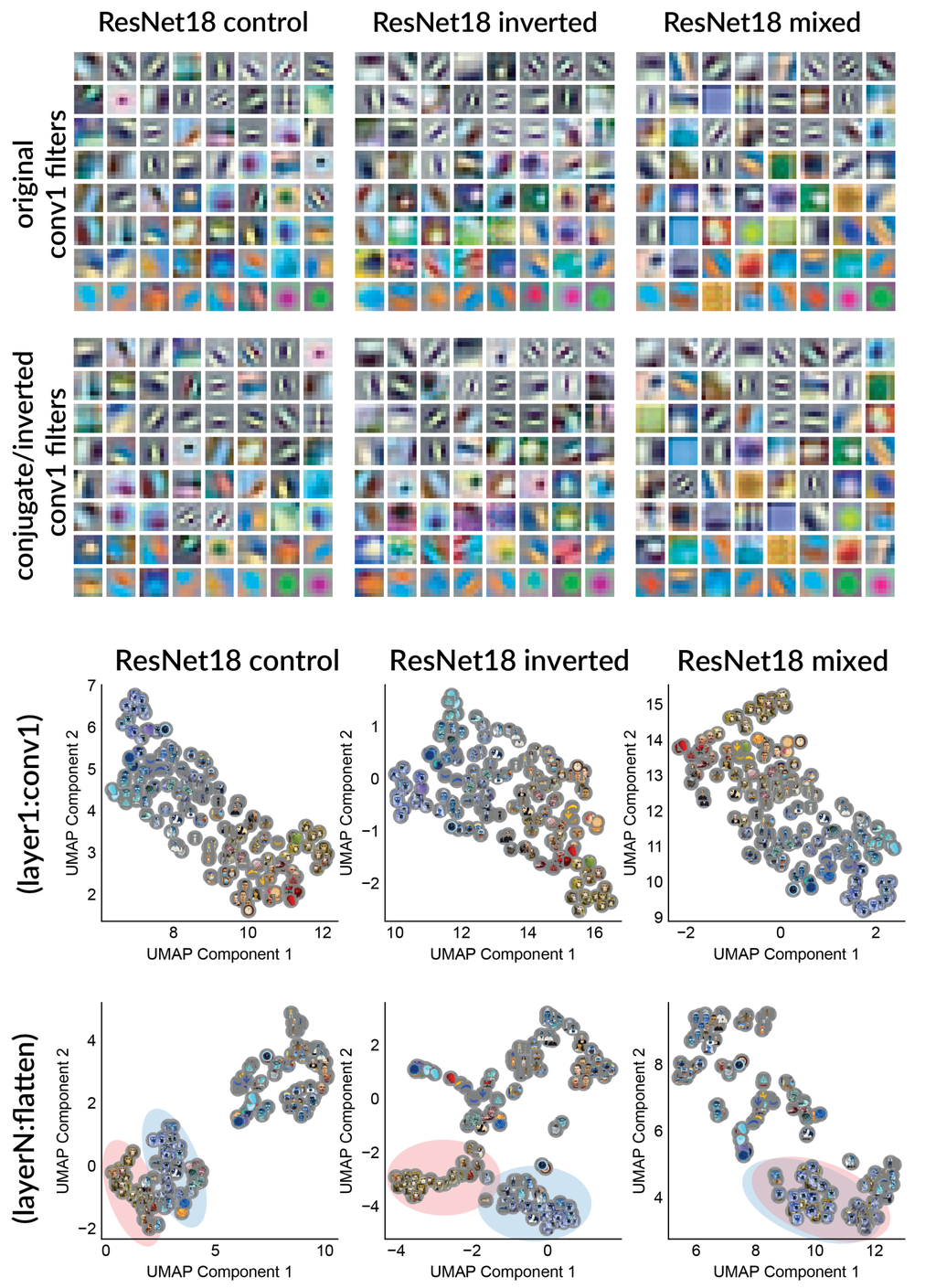

Figure 5. Training ResNet18 on Imagenet1K for 16 epochs with normal, inverted and 50/50 normal/inverted mix of training images.