Neurally-derived representations for face detection

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Internal templates for face detection

- what are the behavioral / neural templates guiding human face detection and how can we estimate them?
- we use noise-based reverse correlation to derive such templates independently from behavioral and neural (fMRI) responses
- previous attempts were only partly successful in revealing a clear visual structure through reverse correlation (Hansen et al, in press)

Reverse correlation estimates

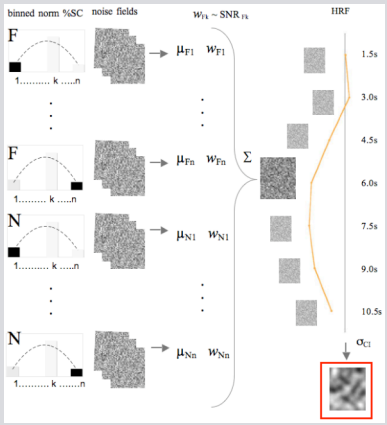
- two participants (EC & EA) complete ~2000 face detection trials with noise / noise + signal stimuli (white noise masks containing a low-contrast average face)
- behavioral & neural responses are recorded over the course of 12 1-hour sessions using a slow event-related fMRI design (2.2 mm isovoxels, 1.5 TR, partial coverage)

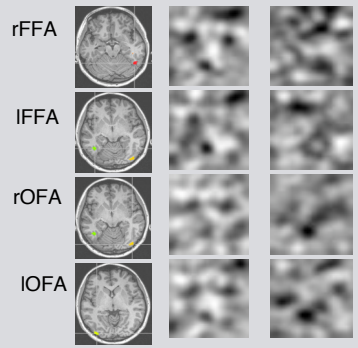
base image noise mask b.i. + noise

- we construct behavioral classification images ("CI"s) using standard reverse correlation for binary responses; we smooth the images and evaluate them using a cluster test

smoothed classification images of our two participants (cyan / magenta mark regions brighter / darker than chance)

- for each participant, for each face-selective area and for each event time point we construct a separate CI: noise masks are separated based on the magnitude of the neural activation they elicit and combined following SNR-optimization for graded responses (Murray et al, 2002); time-locked CIs are weighted by the hemodynamic response function of each region-of-interest (ROI) and combined into ROI-specific classification images





- neurally-derived CIs reveal information beyond that due to the correlation of behavioral and neural responses: similar CIs are obtained after regressing out behavioral responses from the neural signal
- the contrast structure present in the CIs contains elements highly diagnostic for face detection (Viola & Jones, 2004)

CIs averaged and symmetrized

contrast features highly diagnostic for face detection

Summary

- we apply noise-based reverse correlation to fMRI signals associated with high-level visual processing
- CIs reveal a coherent robust contrast structure: an 'invariant-like' template for face detection
- the template found contains contrast elements highly diagnostic of faces as a visual category

References

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