The Relationship Between Multivariate Pattern Classification Accuracy and Hemodynamic Response Level in Visual Cortical Areas

Peter J. Kohler, Sergey V. Fogelson, Eric A. Reavis, Jyothi S. Guntupalli, Peter U. Tse

Department of Psychological and Brain Sciences, Dartmouth College, New Hampshire, USA

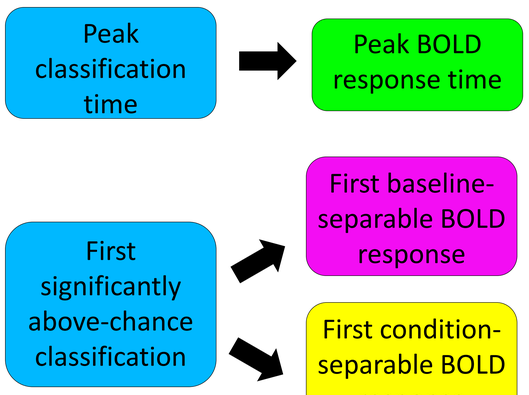
Vision Sciences Laboratory

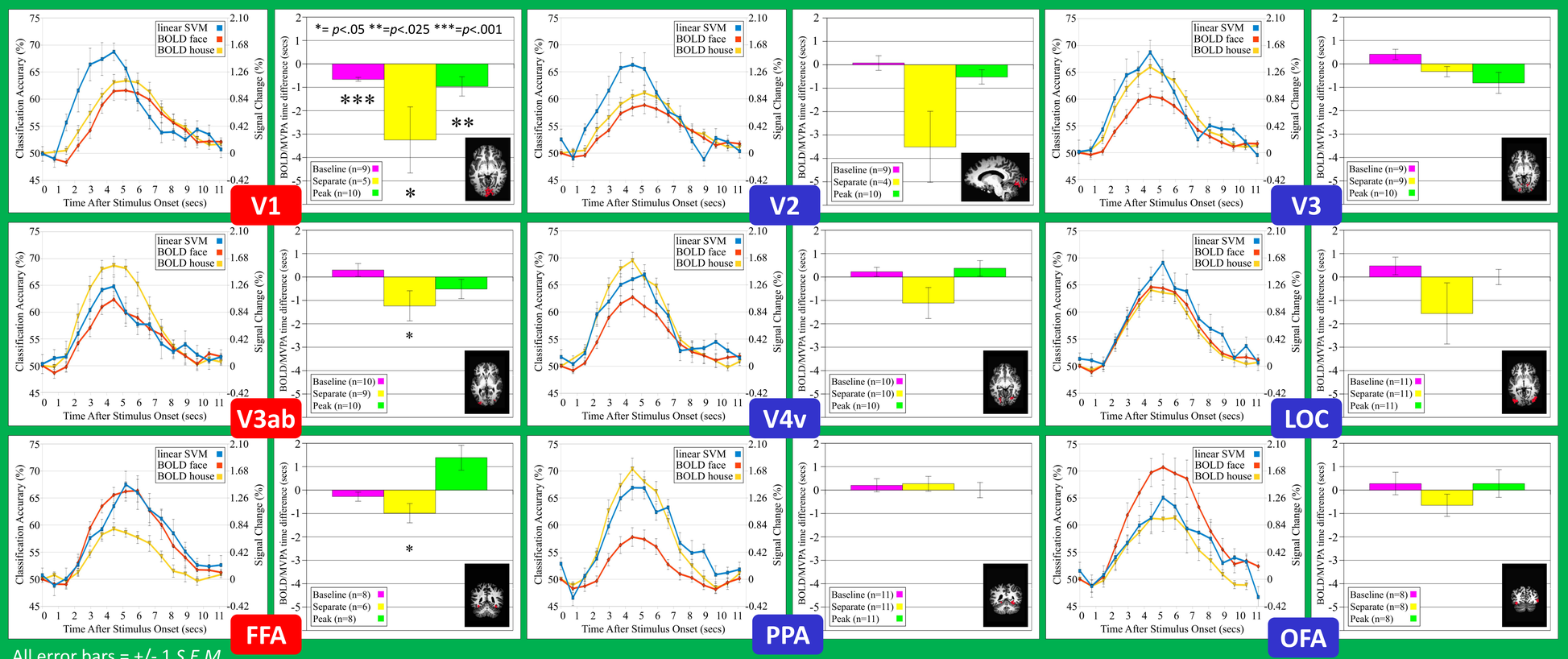
Goal

Compare the timecourse of information availability in multivariate and univariate BOLD signal level analyses

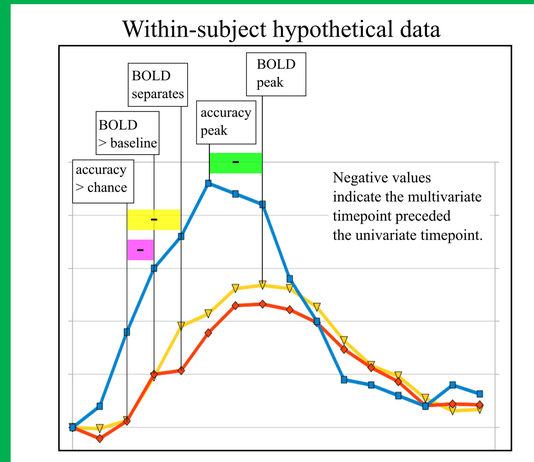
Methods

- Fast PRESTO sequence (17 axial slices, 3 mm isometric, 739 ms acquisitions)
- Subjects viewed pictures of faces and houses (ISI: 15 acquisitions = 11.1 sec.)
- MVP analysis (PyMVPA[1]):
  - SVM classifier trained on each functionally defined ROI
  - Tested using leave-one-run-out cross-validation for every timepoint
- Univariate analysis:
  - Values within each ROI converted to % signal change (AFNI[2]), averaged for each timepoint per condition
  - Within-subject *t*-values calculated at each timepoint for three distinct comparisons:





All error bars = +/- 1 *S.E.M.*



Results

- Above-chance classification preceded hemodynamic baseline deviation in V1
- Above-chance classification preceded conditional hemodynamic separation in V1, V3ab and FFA .
- Peak classification accuracy preceded the peak hemodynamic level in V1.

Conclusions

- Information sufficient to discriminate stimulus conditions is available in multivariate patterns of BOLD activity before it is available in the univariate signal level in early visual areas
- Peak classification accuracy in V1 preceded the univariate peak BOLD signal
- Remarkably, the information is available in the signal pattern:
  - Before the signal level has deviated from baseline in V1
  - Before univariate stimulus responses deviate from each other in V1, V3ab, and FFA

[1] Hanke, M., Halchenko, Y. O., Sederberg, P. B., Olivetti, E., Fründ, I., Rieger, J. W., Herrmann, C. S., Haxby, J. V., Hanson, S. J., & Pollmann, S. (2009). PyMVPA: A Unifying Approach to the Analysis of Neuroscientific Data. Frontiers in Neuroinformatics, 3:3.

[2] Cox, R. W. (1996). AFNI: Software for analysis and visualization of functional magnetic resonance neuroimages. Computers and Biomedical Research, 29: 162-173.

Acknowledgements: We thank Jim Haxby, Ming Meng, Won Mok Shim, Yu-Chien Wu, Yarik Halchenko, and Michael Hanke for helpful suggestions.
Special thanks go to Ziad Saad for timely help with retinotopic mapping.