International Journal of Biomedical Imaging
Volume 2006 (2006), Article ID 79862, 13 pages
doi:10.1155/IJBI/2006/79862



# Reciprocal Benefits of Mass-Univariate and Multivariate Modeling in Brain Mapping: Applications to Event-Related Functional MRI, $H_2{}^{15}O$-, and FDG-PET

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Received 9 February 2006; Revised 17 August 2006; Accepted 18 August 2006

## Abstract

In brain mapping studies of sensory, cognitive, and motor operations, specific waveforms of dynamic neural activity are predicted based on theoretical models of human information processing. For example in event-related functional MRI (fMRI), the general linear model (GLM) is employed in mass-univariate analyses to identify the regions whose dynamic activity closely matches the expected waveforms. By comparison multivariate analyses based on PCA or ICA provide greater flexibility in detecting spatiotemporal properties of experimental data that may strongly support alternative neuroscientific explanations. We investigated conjoint multivariate and mass-univariate analyses that combine the capabilities to (1) verify activation of neural machinery we already understand and (2) discover reliable signatures of new neural machinery. We examined combinations of GLM and PCA that recover latent neural signals (waveforms and footprints) with greater accuracy than either method alone. Comparative results are illustrated with analyses of real fMRI data, adding to Monte Carlo simulation support.