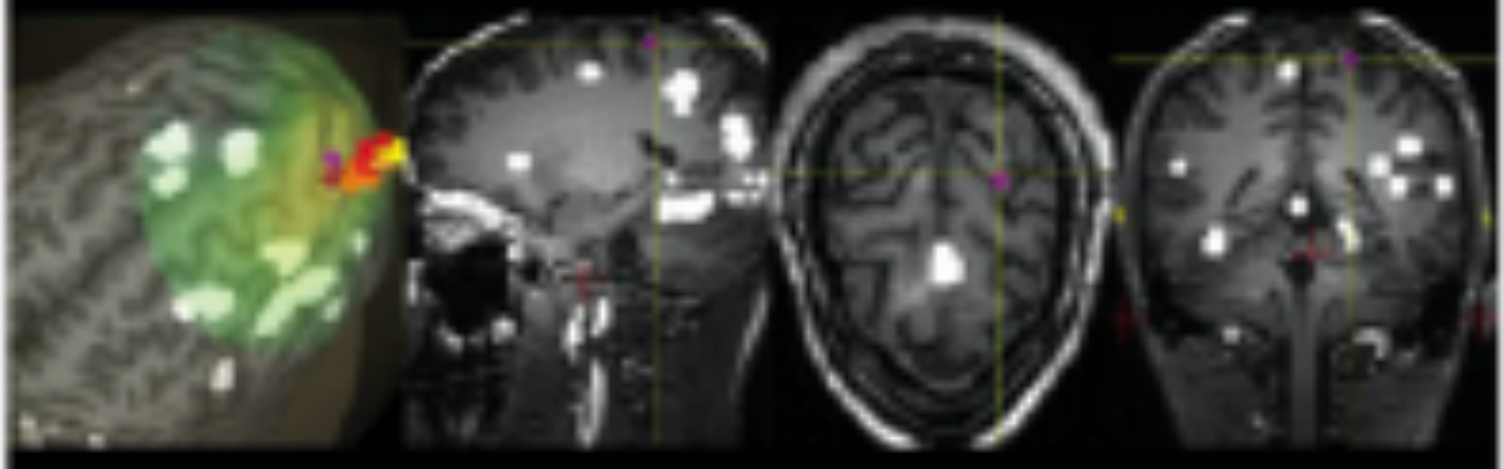
fMRI Methodology

The Problem of Multiple Comparisons

- While not correcting for multiple comparisons can increase the rate of false positives (**Type 1 error**), correcting for multiple comparisons can also make the threshold so high for achieving statistical significance that it becomes very likely that you will be unable to reject the null hypothesis even if it is not true (**Type 2 error**, or a false negative)

  - “Conventional univariate analyses of fMRI data sets are referred to as “massively uni variate,” because a separate statistical test (some variant of the general linear model (GLM), comparable to a t-test) is performed at every voxel. At the level of a whole brain, which typically has > 20,000 voxels, one would expect that 1000 or more voxels would be falsely identified as being “activated” unless one were to apply a correction. The most rigorous is to divide each p value by the number of tests (called **Bonferroni correction)**. For just two voxels, this means that a critical p of .025 needs to be achieved. Not a big deal. But for 20,000, the critical p would drop to .00000025.”

    (Postle, 2015)



ESSENTIALS OF COGNITIVE NEUROSCIENCE

Bradley R. Postle

WILEY Blackwell

METHODOLOGY BOX

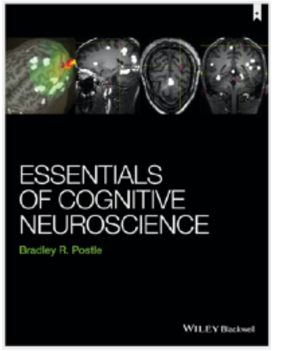
9.2 Some problems, and solutions, with univariate analyses of fMRI data

fMRI Methodology

The Problem of Multiple Comparisons

METHODOLOGY BOX

9.2 Some problems, and solutions, with univariate analyses of fMRI data



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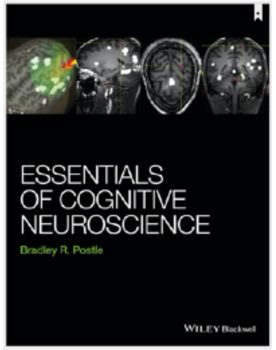

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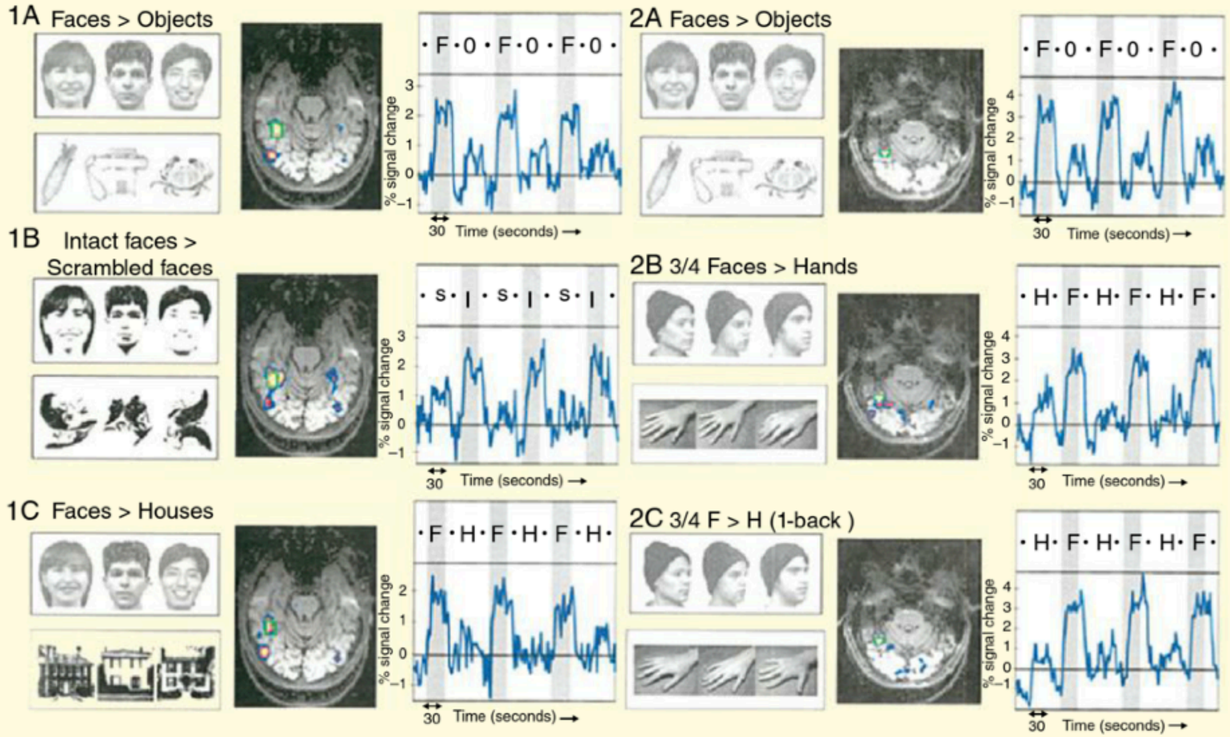

FIGURE 9.3 Examples of stimuli, fMRI statistical maps, and time series, from several assays of response properties of the FFA. The contrast illustrated in panels **1A** and **2A** (faces > objects) was used to define the FFA ROI, outlined in green in the axial images, each for a different individual subject. Panels **B** and **C** illustrate the statistical map generated by each of the contrasts, each for the same subject, with the green-outlined ROI from panel **A** superimposed. This procedure was repeated on the individual-subject data of five subjects, and each time series is the average from the FFA ROI of each. Source: Kanwisher, McDermott, and Chun, 1997. Reproduced with permission of the Society of Neuroscience.

- Kanwisher's work was able to get around the problem of multiple comparisons by using an approach in which, instead of doing an exhaustive number of comparisons involving the activity of individual voxels (start with the first voxel, compare it to every other voxel, then repeat that process again for each voxel) she averaged the activity of many voxels which overlapped with the region of space in which the FFA was located to produce a singular signal
- e.g. Comparison 1A is looking at whether the **region of interest** (**ROI**, in this case the FFA) is more active when looking at faces, as compared to objects