

## ***Review of Cluster failure: Why fMRI inferences for spatial extent have inflated false-positive rates***

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This paper discusses inflation of empirical familywise error rates (FWE) when using packages like SPM, FSL and AFNI to analyze fMRI data. fMRI is a popular tool to study brain function and the authors validated these statistical analysis software using real resting-state fMRI data. The authors find that all three packages have conservative voxelwise inference and invalid clusterwise inference for both parametric one and two-sample t tests. Nonparametric permutation test is better to produce nominal results and less inflated FWE. The authors claim that the reason is the incorrect assumption of squared exponential structure in the parametric models. In the end, the authors call for evaluation of current statistical methods using real fMRI data and highlight the importance for data sharing. The discussants evaluated further of the controversy in the fMRI statistical analysis methods and the authors give response to their comments.

The authors here mainly want to point out that parametric statistical methods are based on many assumptions which may not always be valid for fMRI data. As Brown and Behrmann said, we need to be cautious about using the build-in methods in the software programs as some of them are more complex than we thought. The nonparametric statistical methods may be a good alternative, but more universal methods should be developed. Although some of the extreme results in the paper were picked up by the press which raised a huge debate on the validity of fMRI analysis, the authors' main goal is to ask people to pay more attention to the evaluation of the existing methods. fMRI data have a low signal-to-noise ratio and thus, we need to develop better validated methods to increase the signal-to-noise ratio and extract useful information. Data sharing and open-source code would encourage more people to independently validate the methods especially using real data from different settings.

### **Question:**

1. Open-source code usually update frequently. Will this create problems as the applied researchers might not be aware of the version difference?