# Functional interpretation of diffusion maps


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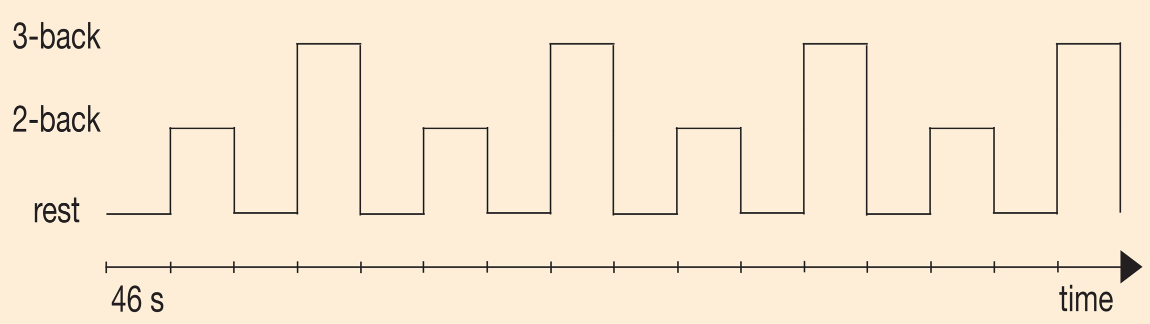
## Introduction

The complexity of connectivity data can be rendered meaningful through dimensionality reduction. Here we employ the non-linear technique of diffusion embedding [1] to functional connectivity maps derived during rest and the performance of an n-back task.

## Methods

**Task**

We have used object n-back task, with 2- and 3-back conditions intertwined with rest blocks.




**MRI data**

27 subjects have participated in the study. During MRI session, 6-minute resting-state session was acquired, as well as two runs of n-back task.

**Data analysis**

Standard resting-state fMRI preprocessing was applied. The diffusion maps were generated using mapalign [2]. The maps were registered to a common subspace using STATIS [3]. First two diffusion maps were chosen for analysis. Maps for rest and task were compared using permutation testing implemented in PALM [4].

## Results

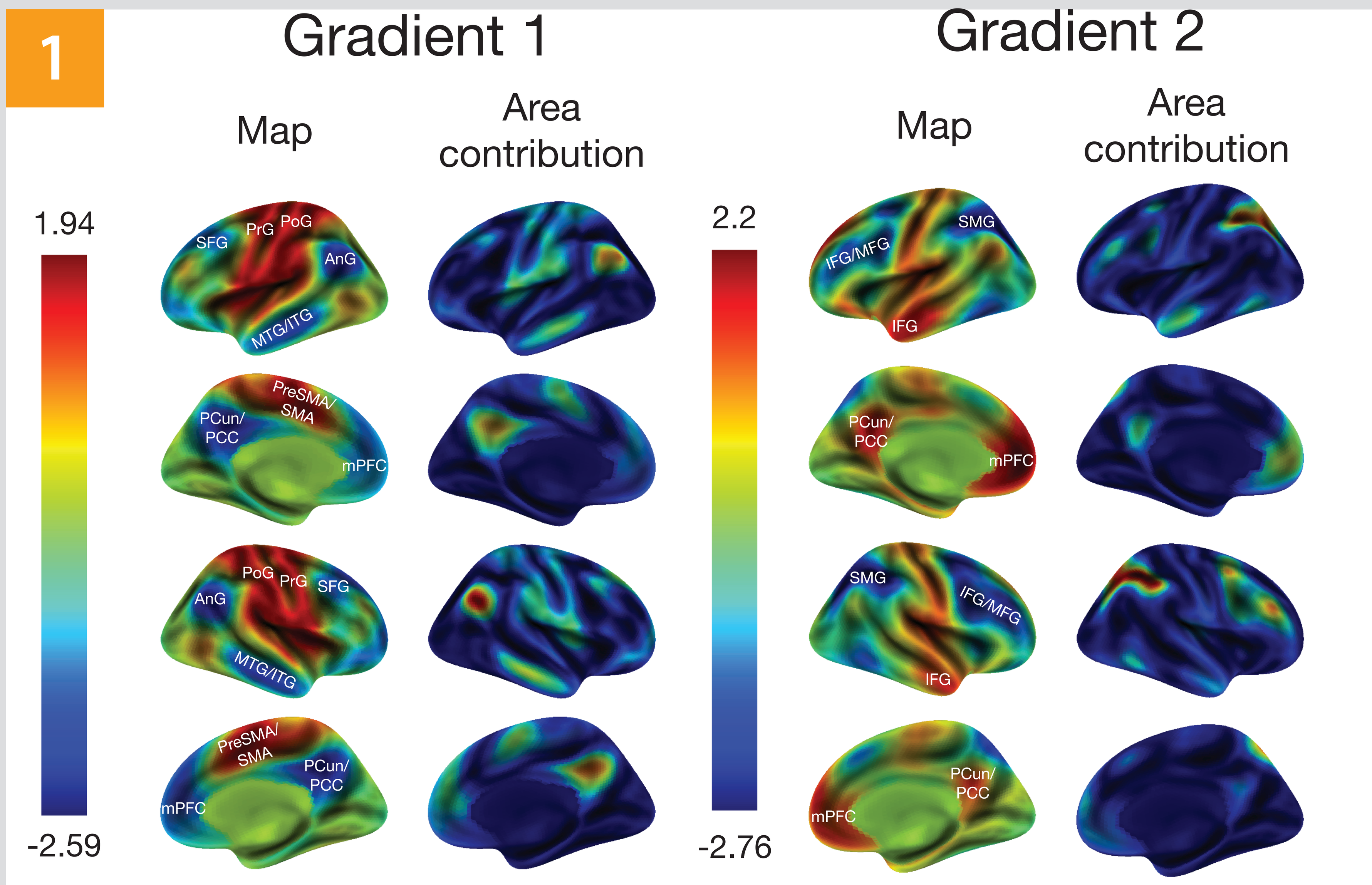



Figure 1. Spatial maps for first two template gradients generated by STATIS.


Figure 2. Joint coordinates of first two gradients in the embedded space. Colors are based on Yeo parcellation [5].

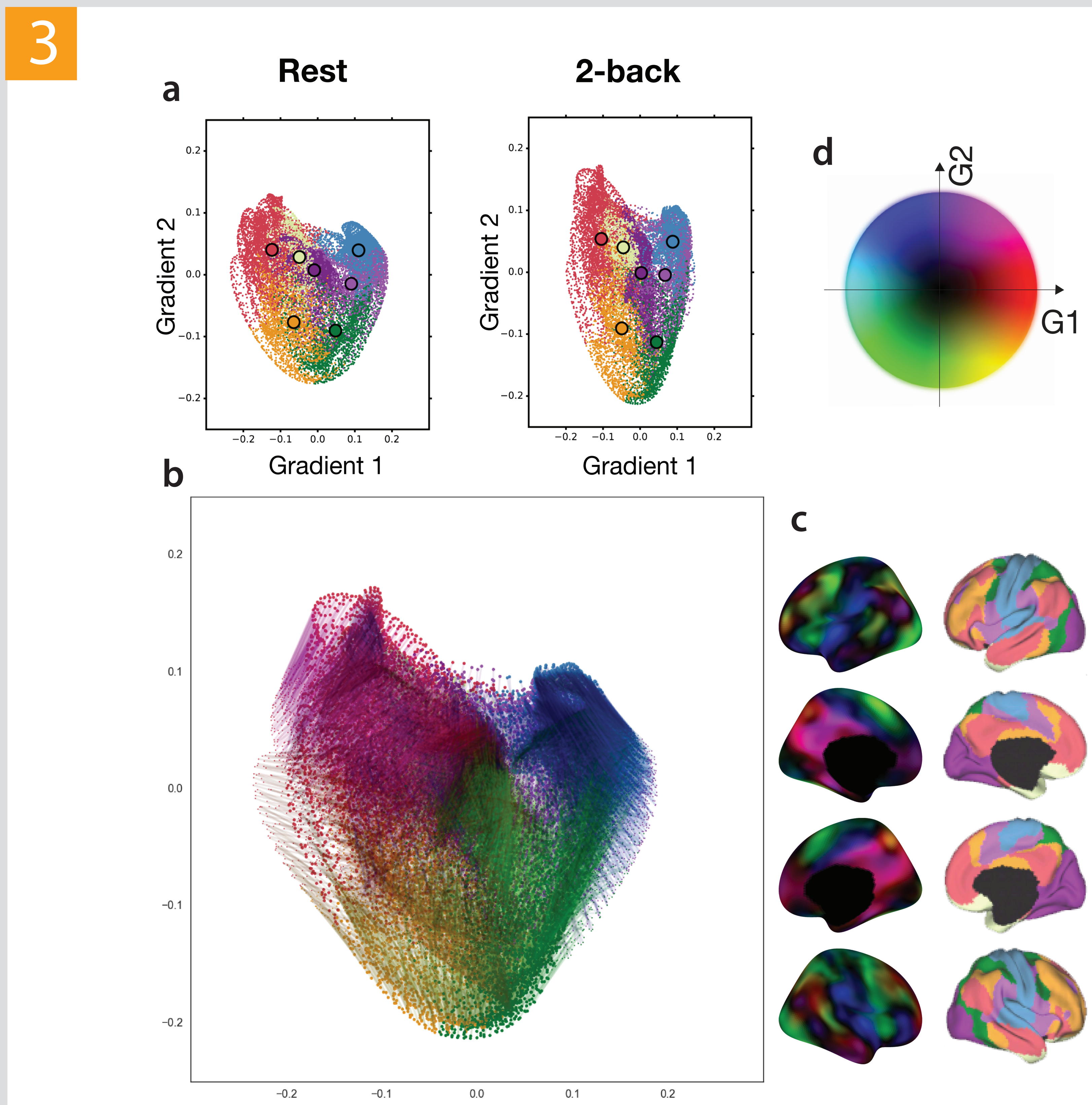



Figure 3: Different depictions of rest-2back differences: a). the geometry of embedded space presented separately for rest and 2-back conditions b). differences between rest (small dots) and 2-back (large dots). Dot colors indicate Yeo 7-Network parcellation [5]. The colors of lines indicate direction in which the individual vertices have moved in the embedded space (d) c). direction of change overlaid on the brain. Colors indicate direction of change in the embedded space (d).

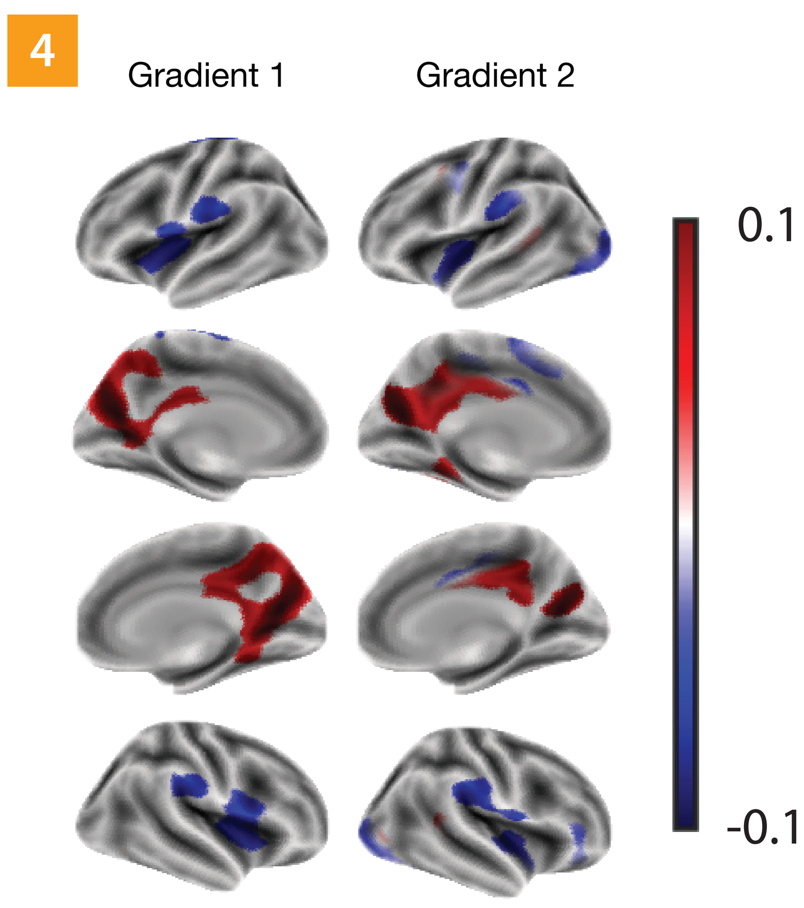



Figure 4. Areas which have significantly shifted along the respective gradients (Z > 3.1, FWEp < 0.05).

## Conclusions

**1. Diffusion maps recover well-established resting state networks and relationships between them in data-driven way**

**2. The contraction of gradient 1 indicates higher integration between somatomotor/ventral attention and default-mode network (DMN), consistent with the proposed role of DMN in integration of the global workspace [6]**

**3. The expansion of gradient 2 reflects the separation of DMN and somatomotor from fronto-parietal/dorsal attention netoworks, consistently with theories emphasizing the role of DMN attenuation for successful task performance [7]**

**4. Non-linear dimensionality reduction techniques ofer a novel coordinate space for describing changes in functional connectivity [8]**

## References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