ALTERED PROPERTIES IN THE CORTICAL THICKNESS NETWORK OF PATIENTS WITH OBSESSIVE-COMPULSIVE DISORDER

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INTRODUCTION

Obsessive–compulsive disorder (OCD) is an anxiety disorder characterized by intrusive, distressing thoughts and ritualistic, repetitive behaviors [1]. In spite of many theory-driven neuroimaging studies [2], few studies have examined alteration of the whole network in OCD [3]. In this study, we examined the cortico-cortical connectivity using cortical thickness and characterized abnormal network efficiency in OCD [4].

METHODS
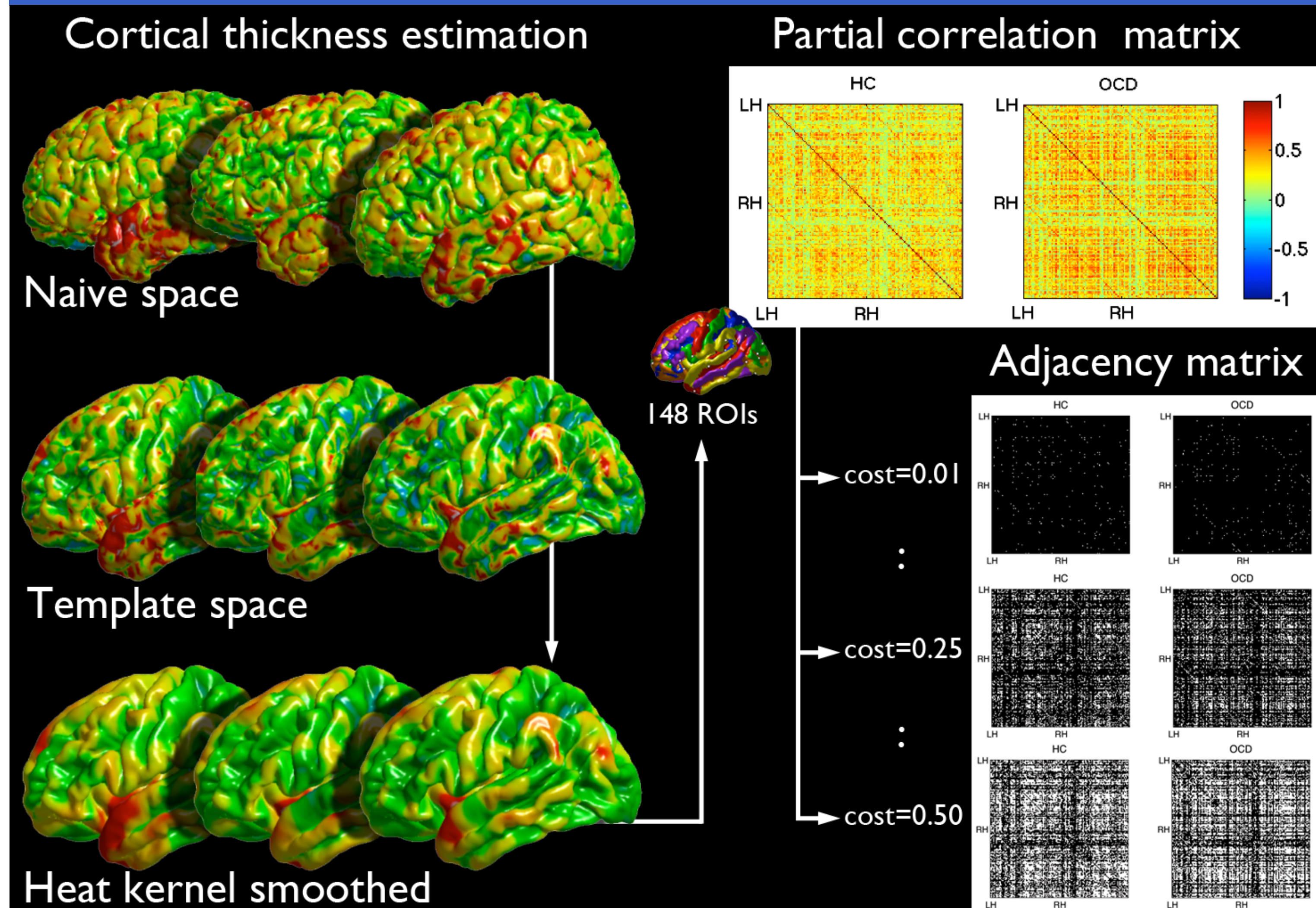
Figure 1. Pipeline of the proposed analysis. Cortical thickness estimated in the native space was normalized onto the template surface and smoothed using heat kernel. Between the 148 ROIs, partial correlation were estimated and binarized to match cost (edge density).

Images & JD: T1-weighted MRI were collected using a 3T GE SIGNA scanner from 32 OCD patients and 35 age and gender-matched healthy controls (HC). All OCD patients were not medicated at the time of study. Cortical surfaces and cortical thickness were obtained using FreeSurfer, then filtered using heat kernel smoothing (bandwidth σ=10, 4000 Laplace-Beltrami eigenfunctions) [6]. We used 'Destrieux 2009 atlas' in FreeSurfer to define 74x2 regions of interest (ROI) to average thickness measures. We computed the partial correlation between ROIs while factoring out the effect of age and gender by such a GLM:

$$\text{thickness} = \beta_0 + \beta_1 \cdot \text{age} + \beta_2 \cdot \text{gender} + \text{noise}$$

Efficiency of networks: 'Efficiency' measures how the network efficiently exchanges information [5]. The metric is similar to small-worldness [6], but it is more adoptable for real networks since it is also applicable to disconnected networks. Global efficiency (E_G), local efficiency (E_L) and neighboring efficiency (E_i) are given as below [5]:

$$E_G(G) = \frac{1}{N(N-1)} \sum_{i \neq j \in G} \frac{1}{d_{ij}} \qquad E_L(G) = \frac{1}{N} \sum_{i \in G} E_i(G_i) \qquad E_i(G_i) = \frac{1}{M(M-1)} \sum_{m \neq n \in G_i} \frac{1}{d_{mn}}$$

where d_{ij} is the shortest distance between nodes i and j, G is the whole graph with N nodes and G_i is the subgraph of the first neighbors of node i with M nodes.

Statistical Inference: In order to compare the efficiency of network invariantly to edge density (cost), we thresholded positive correlation matrices to match their costs from 0.01 to 0.50 with a step of 0.01. The group differences are inferred using 2000 randomizations.
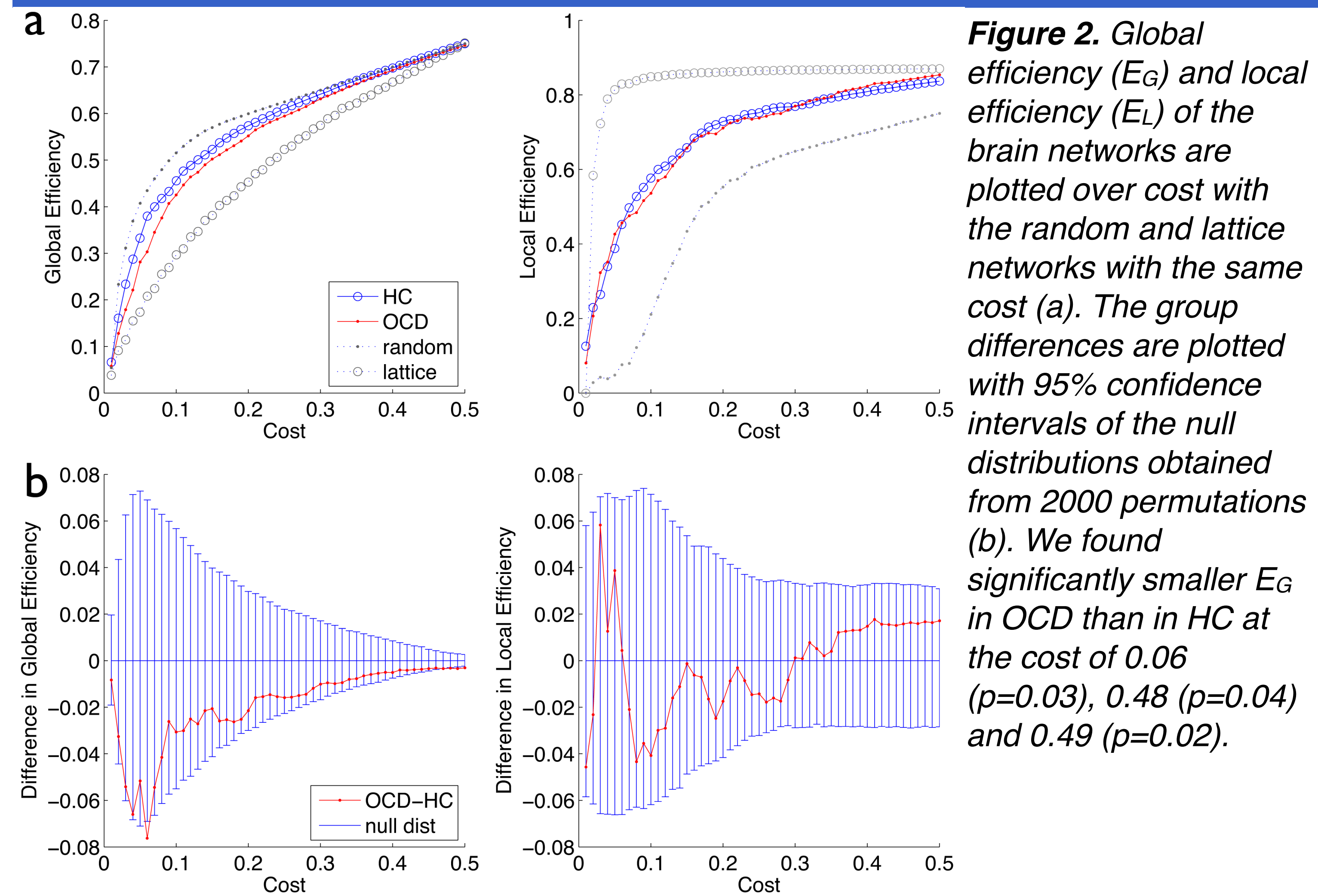
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## ACKNOWLEDGEMENT

RESULTS & DISCUSSIONS

Figure 2. Global efficiency (E_G) and local efficiency (E_L) of the brain networks are plotted over cost with the random and lattice networks with the same cost (a). The group differences are plotted with 95% confidence intervals of the null distributions obtained from 2000 permutations (b). We found significantly smaller E_G in OCD than in HC at the cost of 0.06 (p=0.03), 0.48 (p=0.04) and 0.49 (p=0.02).
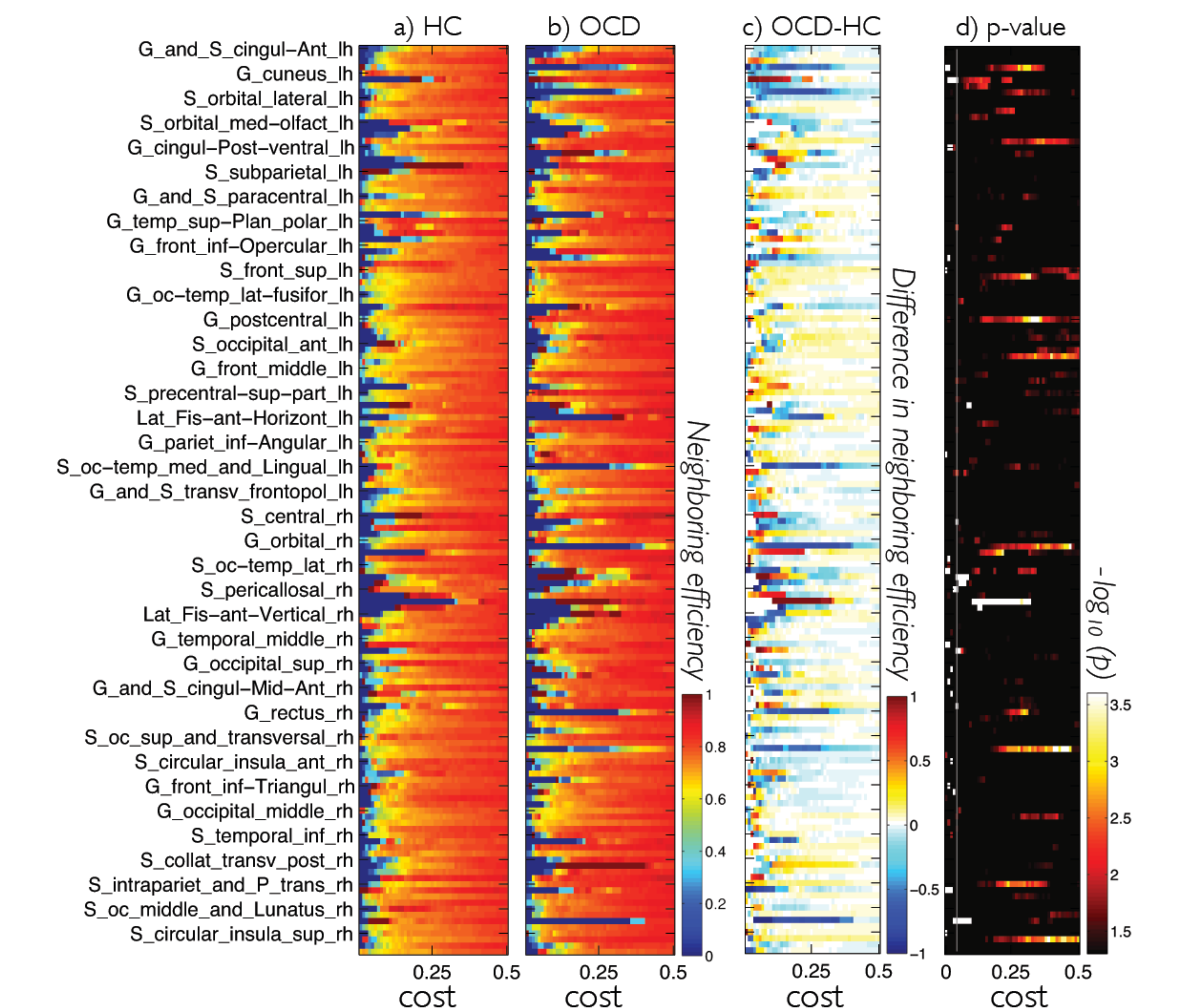
Figure 3. Neighboring efficiency (E_i) for 148 ROIs are plotted over cost for HC (a) and OCD (b). Due to limited space, only 74 ROI labels are shown here. For abbreviation of the labels, see 'Destrieux 2009 atlas' in FreeSurfer. The group differences as HC subtracted from OCD (c) and negative logarithm of p-values (d) are also shown. P-values are thresholded at alpha=0.05. The gray vertical line on (d) indicates the cost of 0.05 visualized in Figure 4.

Figure 4. Binarized networks with cost of 0.05 of HC and OCD overlaid on the template surface. Neighboring efficiency (E_i) is plotted as the size and color of node. The significant group differences in E_i are highlighted with white circles (p<0.05).
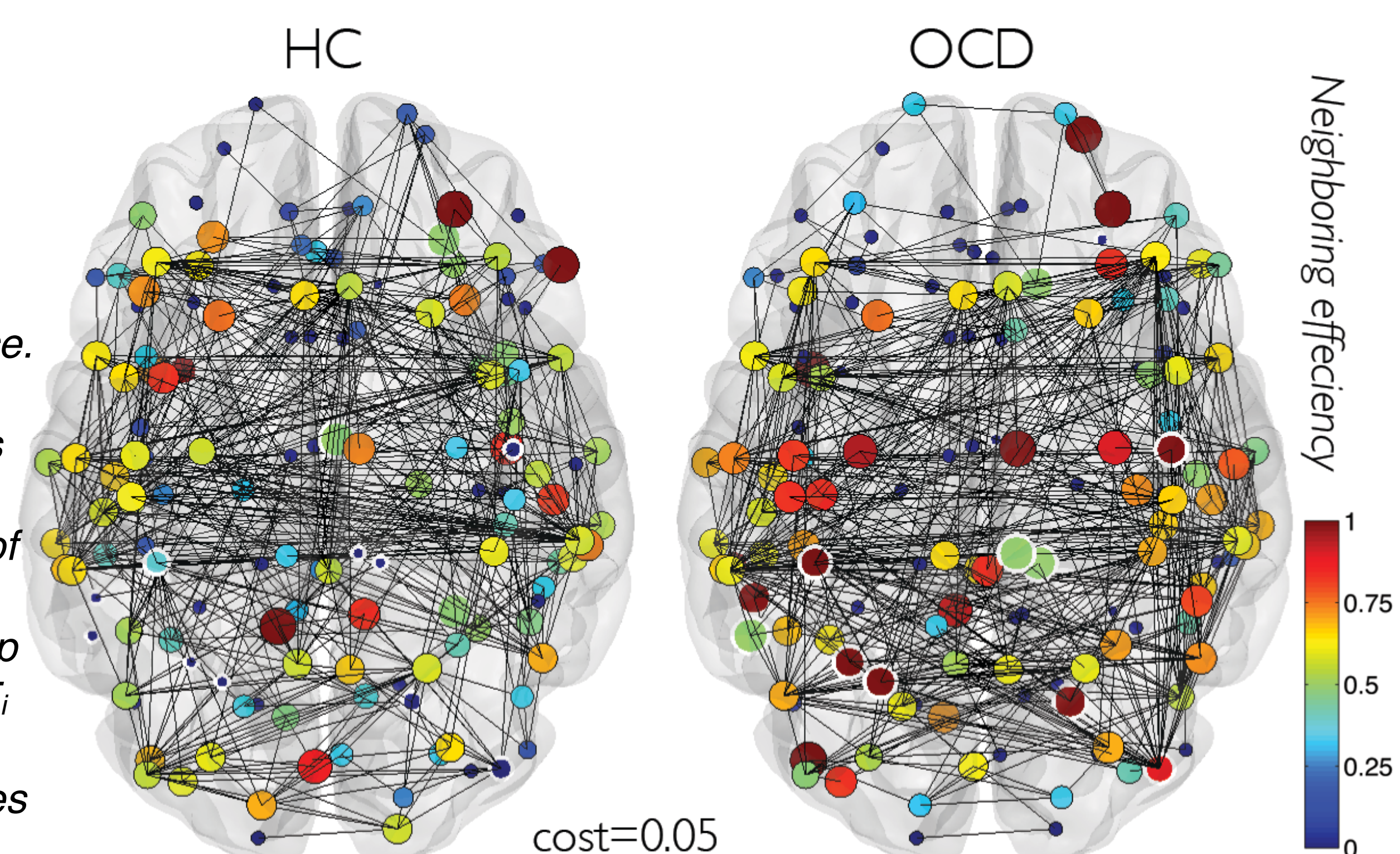
We examined the whole cortical network based on thickness in the patients with OCD and the HC. We found significant group differences in the global efficiency but not in the local efficiency. Additionally, we found significant group differences in neighboring efficiency in the ROIs that are not restricted to the "orbitofronto-striatal" circuits [2]. Further studies may reveal an alteration of the OCD brain network that has been unattended.