Amplitude of brain signals classify hunger status based on machine learning in resting-state fMRI

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Resting-state fMRI (rs-fMRI) is a method of functional brain imaging that allows the task-free exploration of the intrinsic functional connectivity in humans. Since central nervous pathways regulate food intake and eating behavior, it is assumed that changes in the homeostatic state have an impact on the connectivity patterns of rs-fMRI. Here, we compare the accuracy of three data-driven approaches in classifying two metabolic states (hunger vs. satiety) depending on the observed rs-fMRI fluctuations. These methods assess local and global functional connectivity as well as amplitude (intensity) fluctuations of neural signals: First, regional homogeneity (ReHo), which describes the synchronization of time series of a given voxel and its nearest neighbors. Second, the degree of centrality (DC), which measures the number of connections of a voxel to all the other voxels above a certain threshold. Third, the fractional amplitude of low-frequency fluctuation (fALFF), which measures voxel-wise signal amplitude. After extracting the associated connectivity parameters of 90 brain regions for each method, we use features selection algorithms with the objective function of linear support vector machine classifier and permutation tests to investigate which method and which brain regions differentiate best between hungry and satiety. Our results indicate that the fALFF method is more accurate than ReHo and DC in capturing the changes of the resting brain during states of hunger and satiety. This opens up the possibility to use this measure to characterize certain states (e.g., sleep stages) or disease conditions (e.g., mitochondrial encephalopathy).

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