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Differentiation between first-episode psychosis patients and healthy subjects on the basis of precuneus activation

28th ECNP congress, Amsterdam, 29 August - 1 September 2015

Purpose of the study

The brain basis of psychotic disorders remains inadequately understood. In this study we used multivariate machine-learning methods to differentiate brain fingerprints of first-episode psychosis patients and healthy control subjects. Earlier machine-learning classification of functional magnetic resonance imaging (fMRI) data have mainly focused on brain activity of chronic patients and data have been collected during resting-state [1] or simple tasks [2]. However, resting-state results are difficult to interpret because ongoing thoughts and experiences are likely to differ between patients and healthy control subjects. Simple, such as working memory or verbal learning tasks, can match the experience between the groups but capture only a narrow field of information processing and may therefore miss the functions that are most affected in every-day life. We set out to unravel brain activation patterns related to naturalistic stimuli in first-episode psychosis patients and healthy control subjects. We hypothesized that brain networks earlier shown to be affected in psychotic disorders—such as the default mode, executive and salience networks—would be identified as discriminative features between the groups and that the severity of psychotic state would be correlated with the success of classification within the patient group.

Methods

We recorded 3-T fMRI from 46 first-episode psychosis patients and 32 healthy control subjects who viewed episodes with both realistic and supernatural content from the movie Alice in Wonderland [3]. Patients' symptom severity was assessed at baseline and at 2-month follow-up by using the Brief Psychiatric Rating Scale Extended (BPRS-E). Machine learning methods were used to classify patients and healthy control subjects on the basis of both voxel- and time-point patterns.

Results

The majority of (136 out of 194) voxels that best classified the groups were clustered in an anatomically contiguous bilateral region of the precuneus (PC). Seed-based analysis showed the PC region to be functionally connected to default-mode network and middle temporal gyri. Classification accuracies were up to 79.5% ($p = 1.61*10^{-9}$), and the higher classification frequency across several classifiers, the higher were the positive symptom scores of patients.

References

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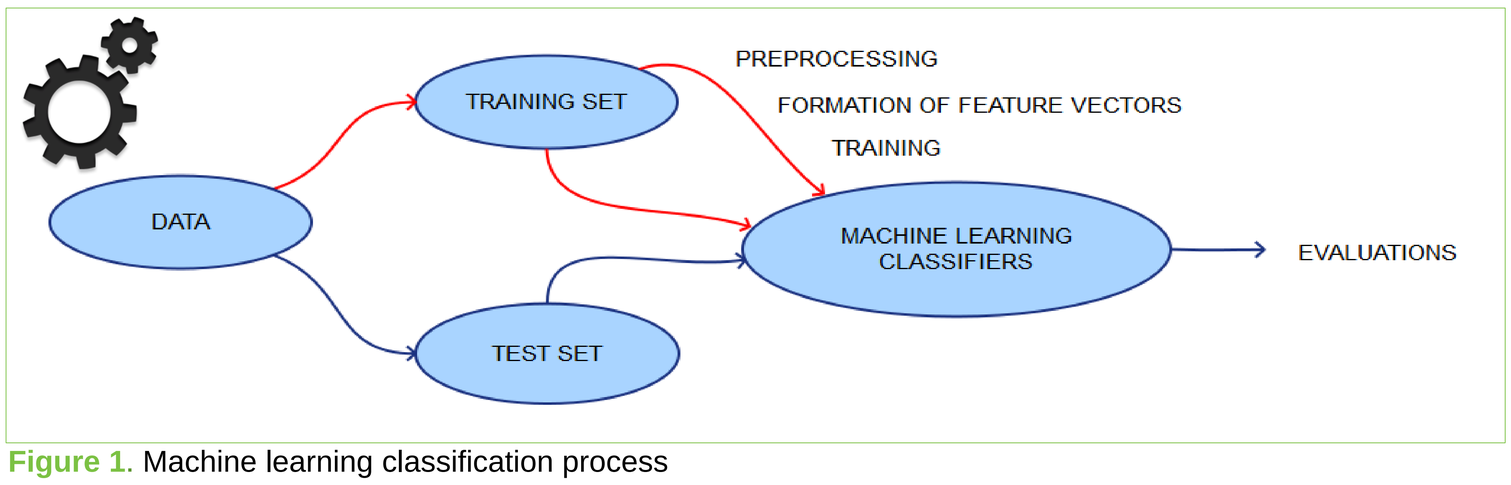

Figure 1. Machine learning classification process

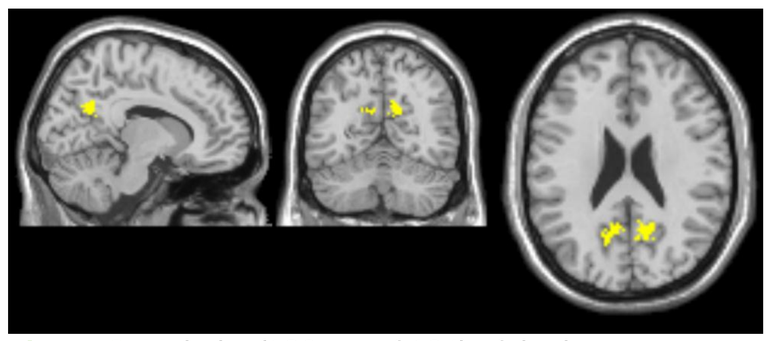

Figure 2. Majority (136 out of 194) of the best classifying voxels were located in the precuneus

Conclusions

These are the first findings to show abnormalities in PC functioning during naturalistic information processing in first-episode psychosis patients. The symptom severity-related findings further propose the association of the functional PC alteration with psychotic state. PC is known as a central hub for the integration of self- and episodic-memory-related information and thus its dysfunction might give insights into understanding of psychosis. Our findings indicate the usefulness of natural stimuli in classification analyses based on brain-imaging data and call for future research on the role of precuneus in psychosis.

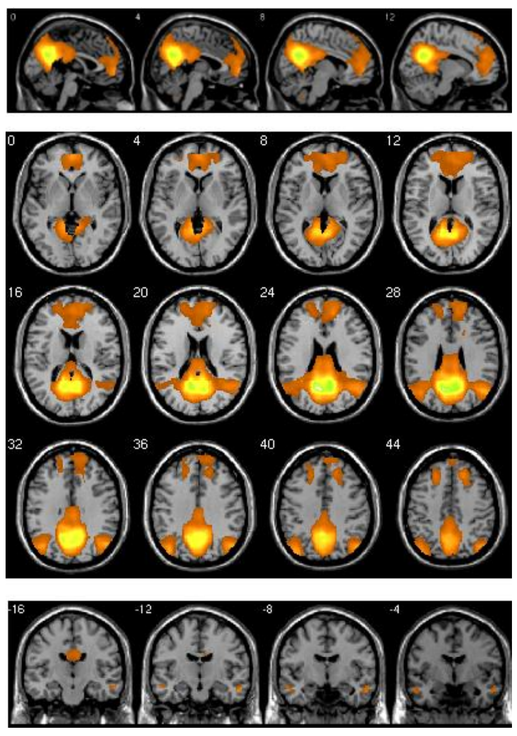

Figure 3. Functional connectivity of the precuneus seed region

Disclosure

The authors have no potential conflicts of interest to declare.

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