NENS stipend training stay report Dennis Hernaus

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Work stay: April 14th 2014 – July 14th 2014

Rationale and technique

I stayed at the Department of Neuroimaging of the Centre for Neuroimaging Sciences at King's College London for 3 months, from April until July 2014. During my training stay, I acquired experience in a variety of neuroimaging techniques labelled *"pattern recognition for neuroimaging"*. Essentially, statistical pattern recognition is concerned with automatic discovery of regularities in data through the use of computer algorithms. With the use of these regularities, actions can be taken such as classifying the data into different categories. Specifically, the aim of my training stay was to investigate if pattern recognition for neuroimaging can be used to identify control subjects (group 1) and psychosis patients (group 2) on the basis of their brain activity (dopamine release measured with positron emission tomography (PET)) during a functional task. The rationale behind this approach is that if such a technique can reliably classify groups, this could serve as a diagnostic tool to label individuals (at risk) for psychosis in the future. For these aims, I was trained to use the Pattern Recognition for Neuroimaging Toolbox (PRoNTo; http://www.mlnl.cs.ucl.ac.uk/pronto/prtsoftware.html) co-developed by the host institute.

Results

Preliminary analyses have revealed that dopamine release during a functional task measured with PET can not serve as a reliable indicator to classify as patients and controls (Correct classification with largest margin classifier: 61%, p=.81). However, when combining the two groups, pattern recognition for neuroimaging can reliable be used to predict behavioural parameters. More specifically, during a stress task, the amount of dopamine release in the prefrontal cortex is associated with the amount of subjectively experienced stress, regardless of group (Figure 1). The certainty (0-100%) with which brain data (dopamine release) are labelled as belonging to a stress task, compared to a carefully designed non-stress task, is correlated with the amount of stress experienced during the task (correlation with classification using cross validation r=.75, p<.01).

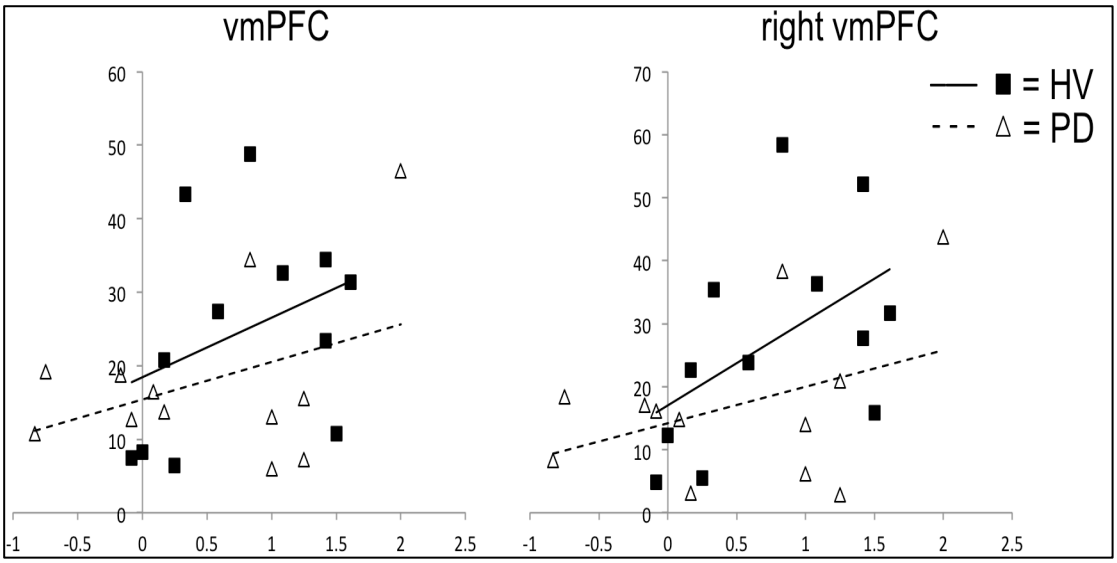
Implementation and future

Acquiring this technique was essential for future studies at my home institute. Currently, Maastricht University is collecting longitudinal brain data of individuals at risk for psychosis, to see who will develop the disorder and who will not. The use of pattern recognition here is essential; this technique can be used to investigate if conversion to a mental disorder can be reliably be classified (e.g. belonging to the patient post conversion and belonging to a control group pre conversion). The newfound expertise will be shared in the form of meetings and 1-day workshops for staff members of my department.

Personal development

With the invaluable help of the Network of European Neuroscience Schools, this work stay has greatly advanced my understanding of recent development in the field of neuroimaging. Hands-on experience at the host department has ensured that I am now able to utilize these essential techniques in future research. Finally, the work stay funded by this stipend resulted in the addition of valuable future collaborators to my network.

Figure 1. Correlation between classification accuracy and behavioural parameters.



Y-axis: certainty that brain data belong to stress condition (100% max.). X-axis= increase in subjectively experienced stress (stress-control condition) on a 7-point scale. This figure indicates that the certainty that brain data belongs to a stress task (compared to control) is associated with the subjectively experience of stress. This validates the idea that categorical predictions about brain data made by pattern recognition techniques can be useful to say something about the subjective state of an individual. The left hand side shows the complete ventral prefrontal cortex while the right hand side contains an a-priori selected region of

interest. Healthy volunteers (HV) and patients with psychotic disorder (PD) showed a similar correlation (no interaction).