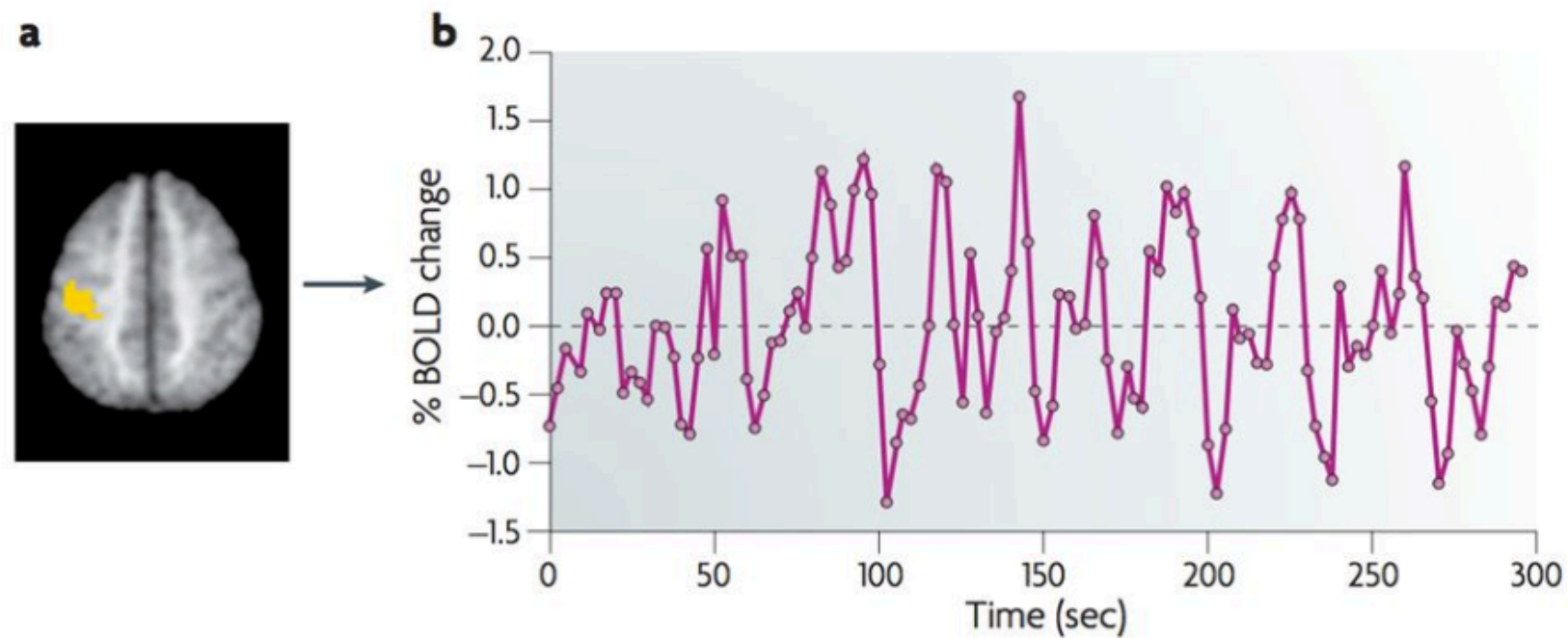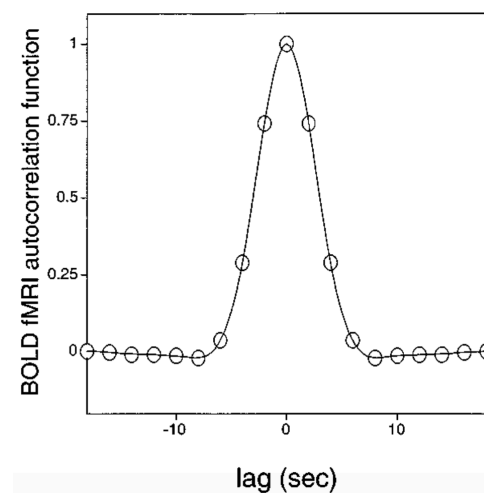Natalia Bielczyk
Pouya Ghaemmaghami
Gregor Koehler
Fabrizio Damicelli
Sarah Morgan
Jean-Loup Loyer
Onerva Korhonen

Trends in the resting brain

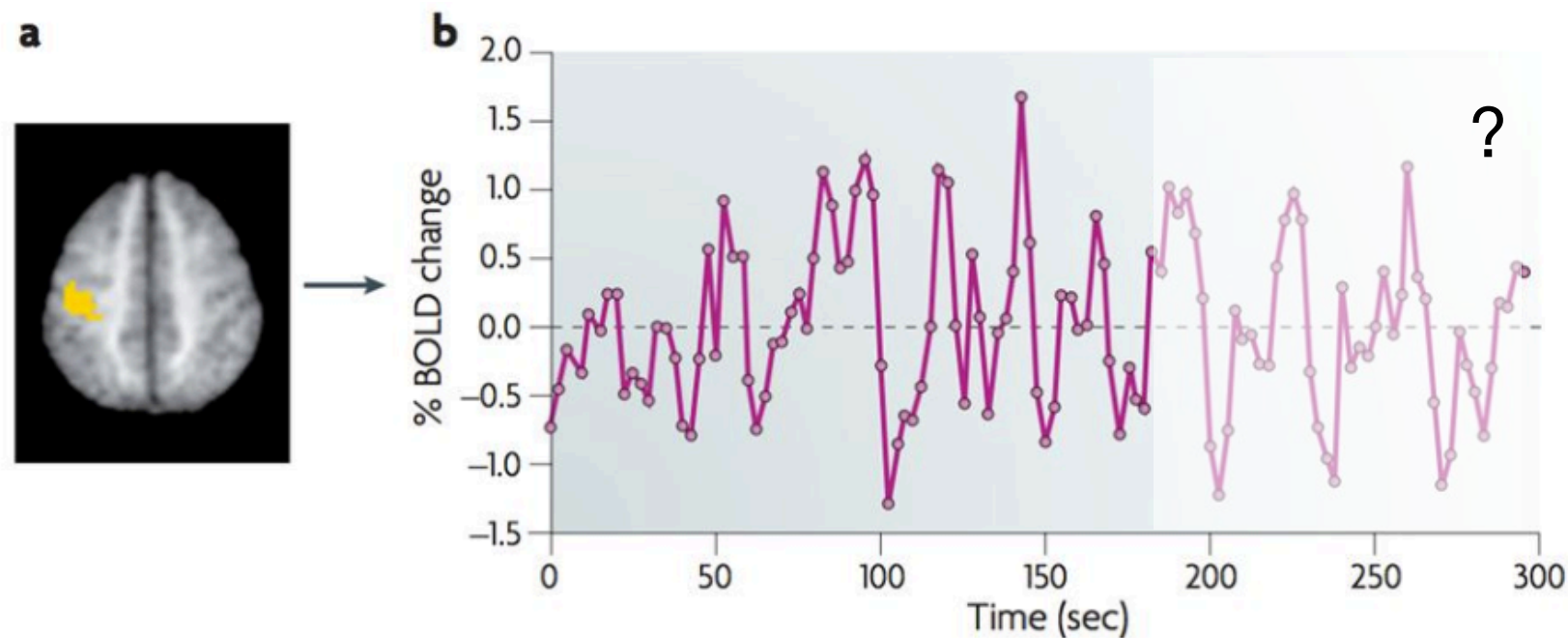# Is resting state BOLD fMRI activity random?

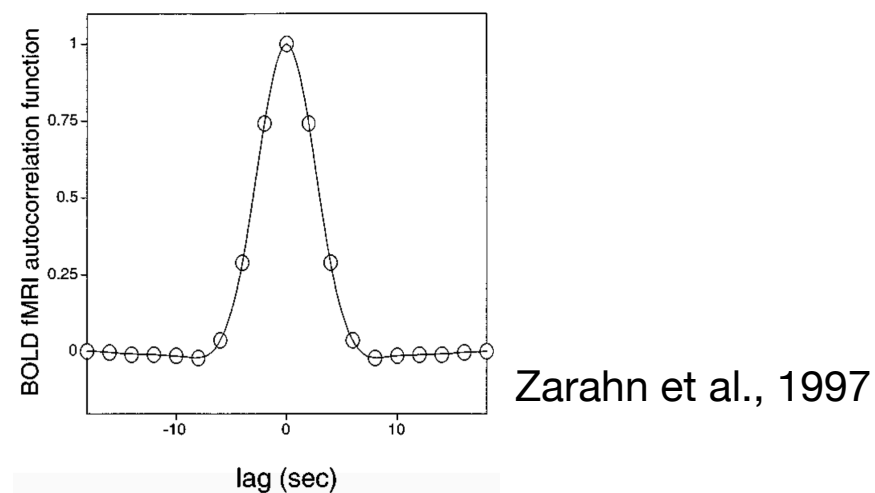- we know that BOLD is autocorrelated because of the slow hemodynamics

Zarahn et al., 1997

Is resting state BOLD fMRI activity random?

- we know that BOLD is autocorrelated because of the slow hemodynamics
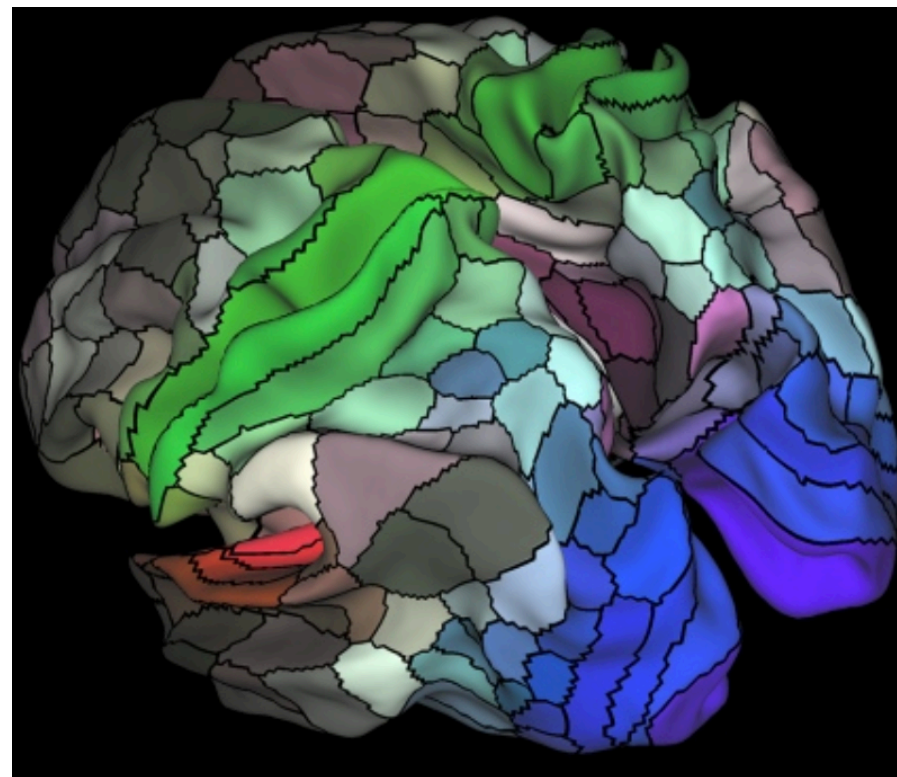

Zarahn et al., 1997

- can we *predict* the future BOLD fMRI values on the basis of historical values? can we *beat* the prediction accuracy coming from autocorrelation?
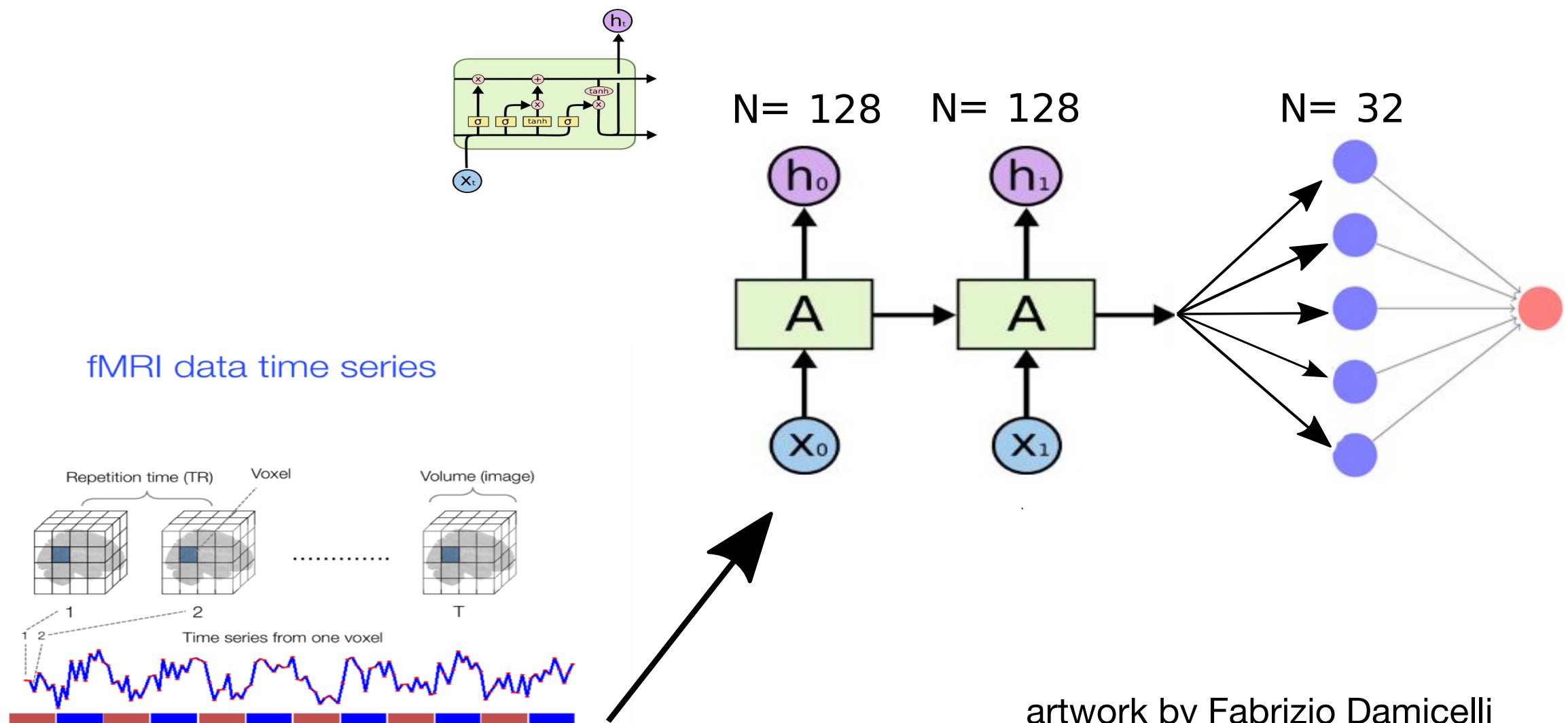
Materials and methods

Datasets

functional Magnetic Resonance Imaging datasets comig from the Human Connectome Project (van Essen, 2013)

> preprocessed using FSL with ICA-AROMA correction for movement artifacts

> parcellated using new cortical parcellation by Glasser et al. (2016) using a trade-off between machine learning and neuroanatomy (180 ROIs)

Machine learning algorithms
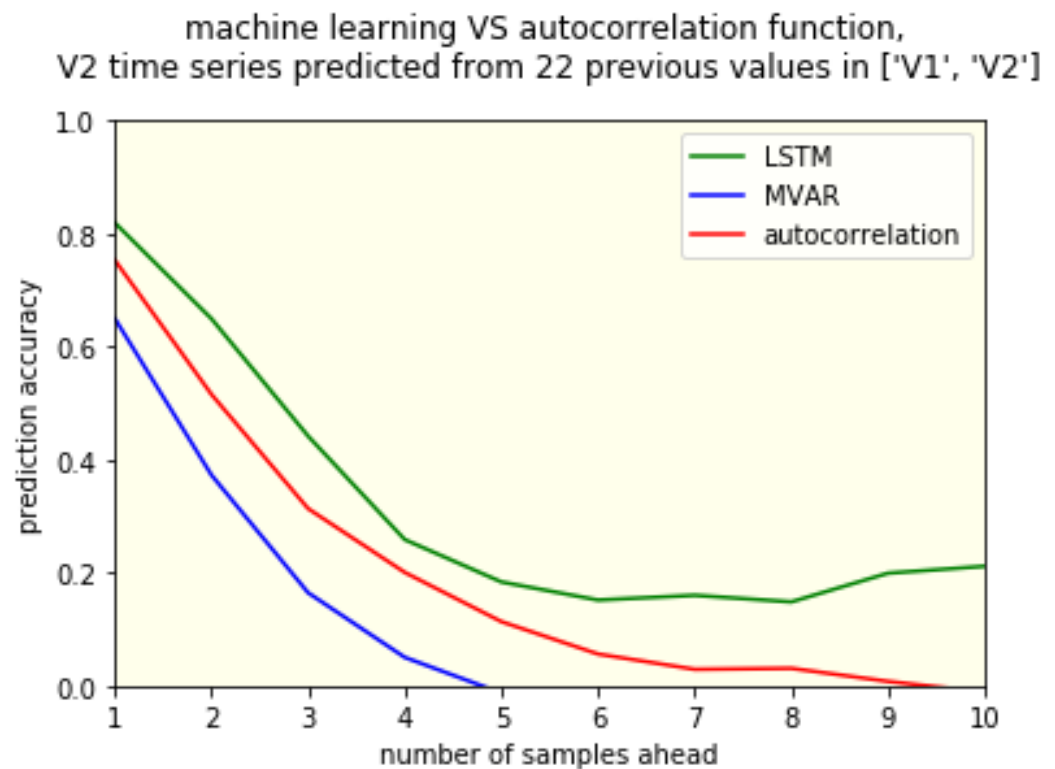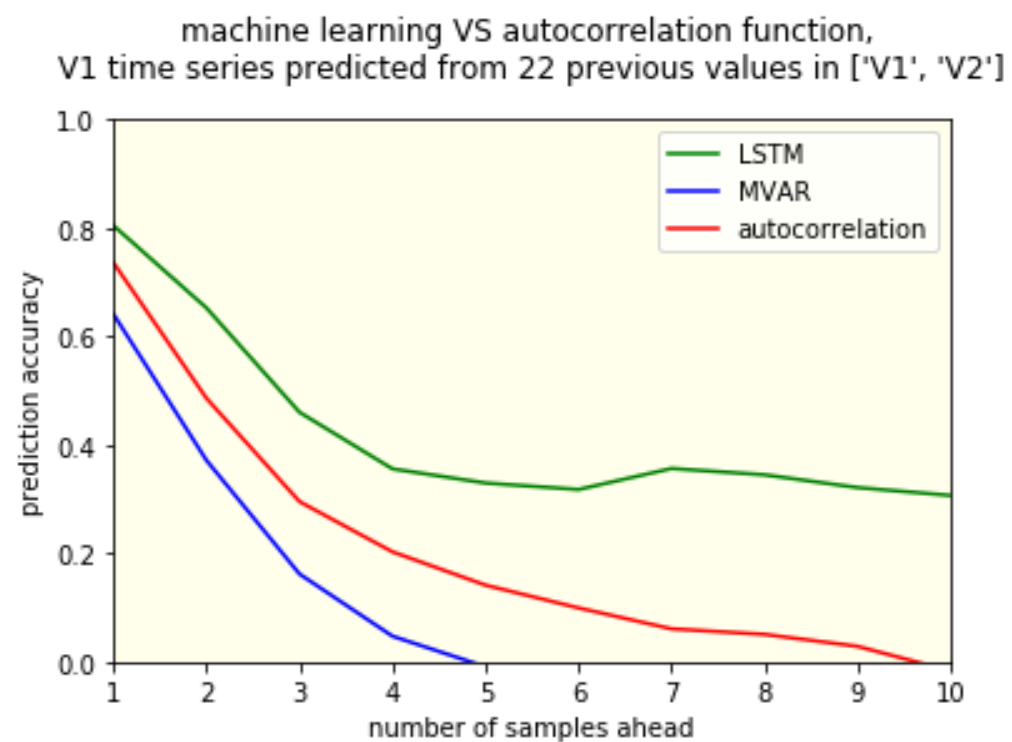
[1] Long short-term memory (LSTM) recurrent neural network

N= 128   N= 128   N= 32

fMRI data time series

Repetition time (TR)   Voxel   Volume (image)

1   2   T

Time series from one voxel

artwork by Fabrizio Damicelli

Machine learning algorithms

[2] Multivariate Autoregressive Models

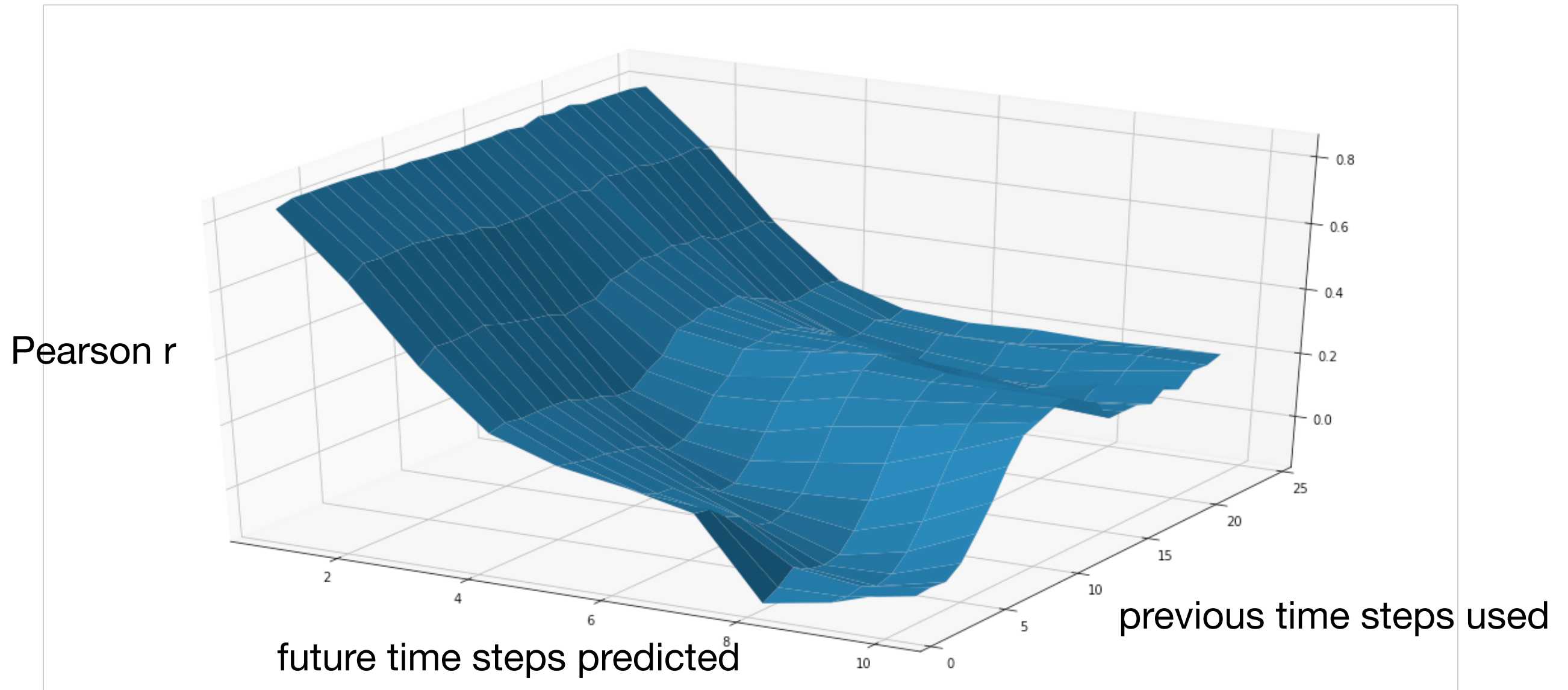$$X_t = c + \sum_{i=1}^{p} \varphi_i \vec{X}_{t-i} + \varepsilon_t$$

Results

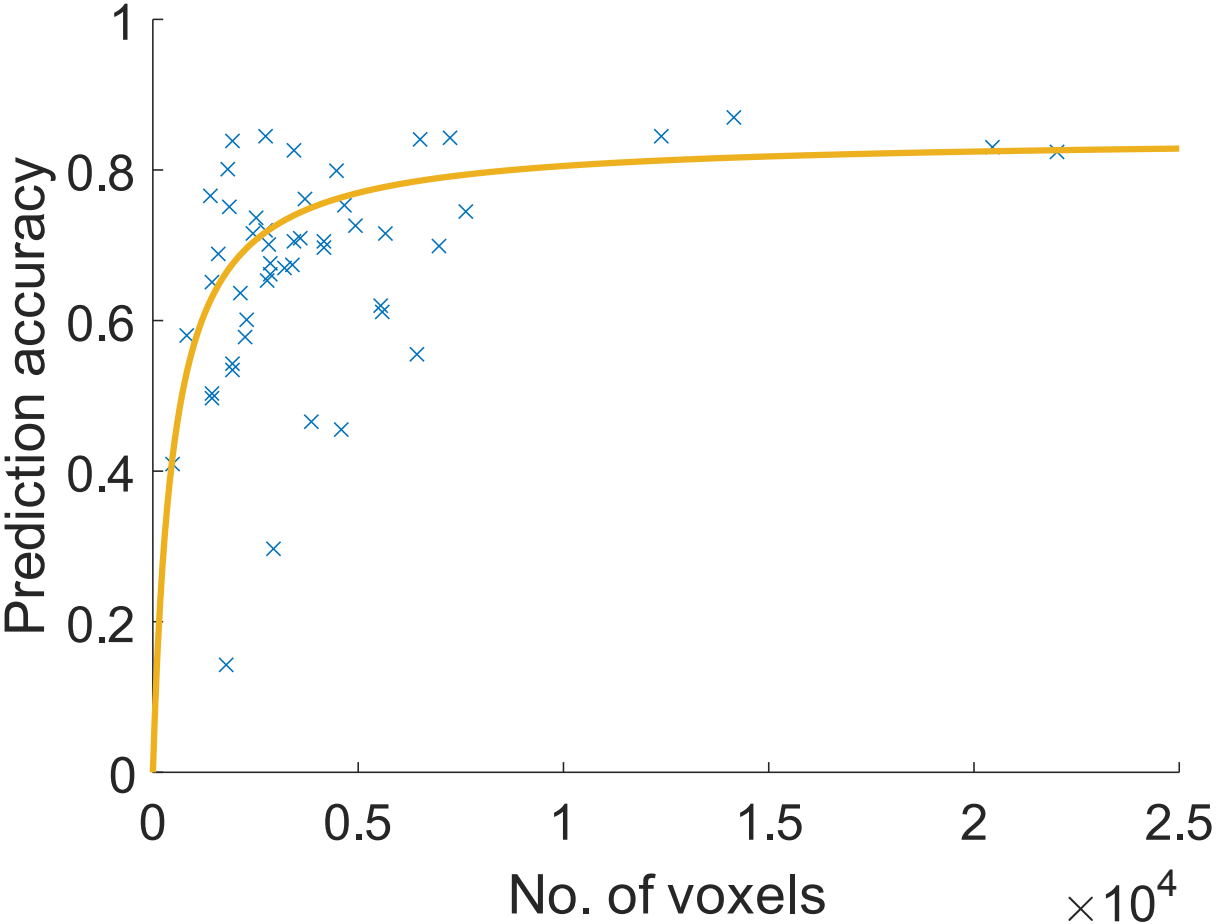comparison between autocorrelation, LSTMs and MVARs (single subject level):
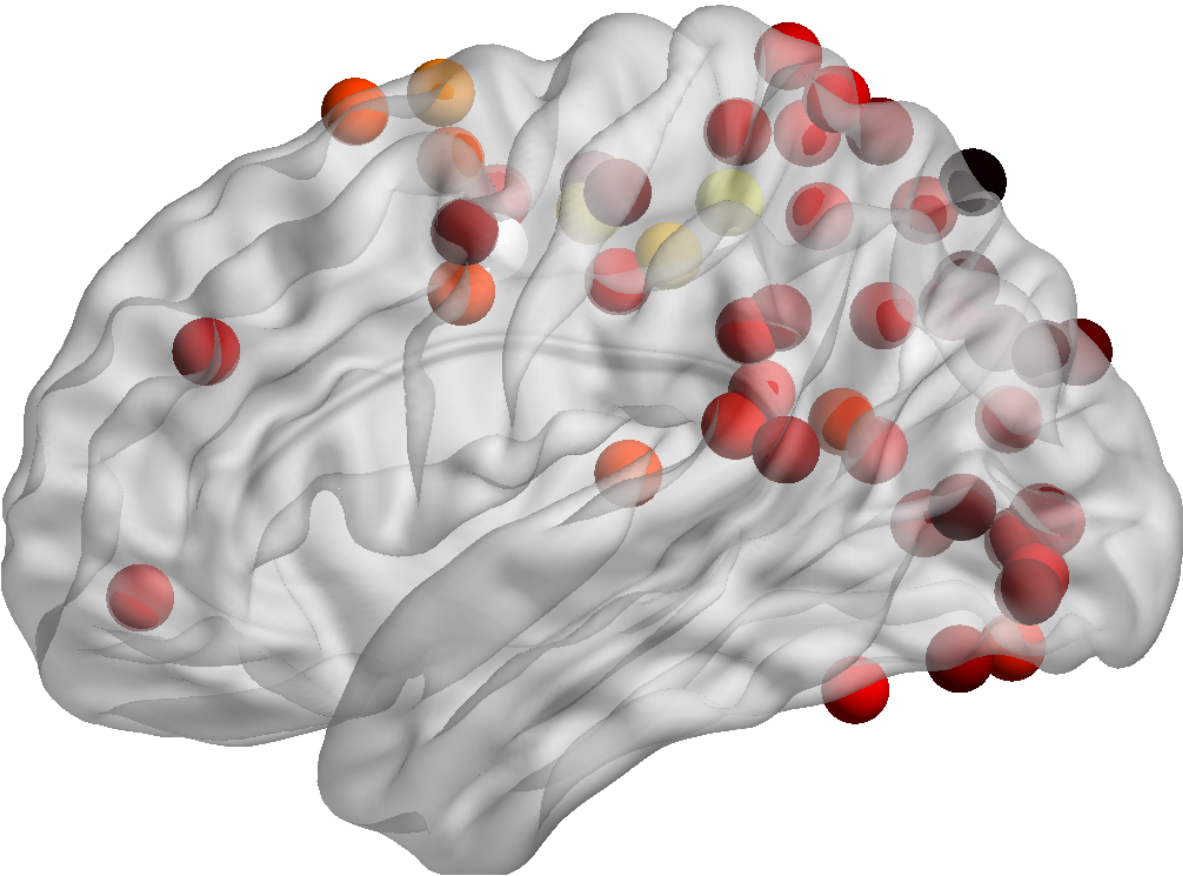
Results

Optimizing parameters for LSTMs

Size of ROI affects prediction accuracy

(LSTMs, one sample ahead)

Size-corrected prediction accuracy

artwork by
Sarah Morgan & Onerva Korhonen

Future work

[1] making the whole brain map of predictability

[2] comparing the results from multivariate AR with the simple linear regression

[3] exchange corrleations with MSE as a measure of accuracy

[4] second level analysis (looking at the cohort level)

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Thank you :)

https://github.com/cryptofan/BrainhackNetworks_indicators_restingstate