

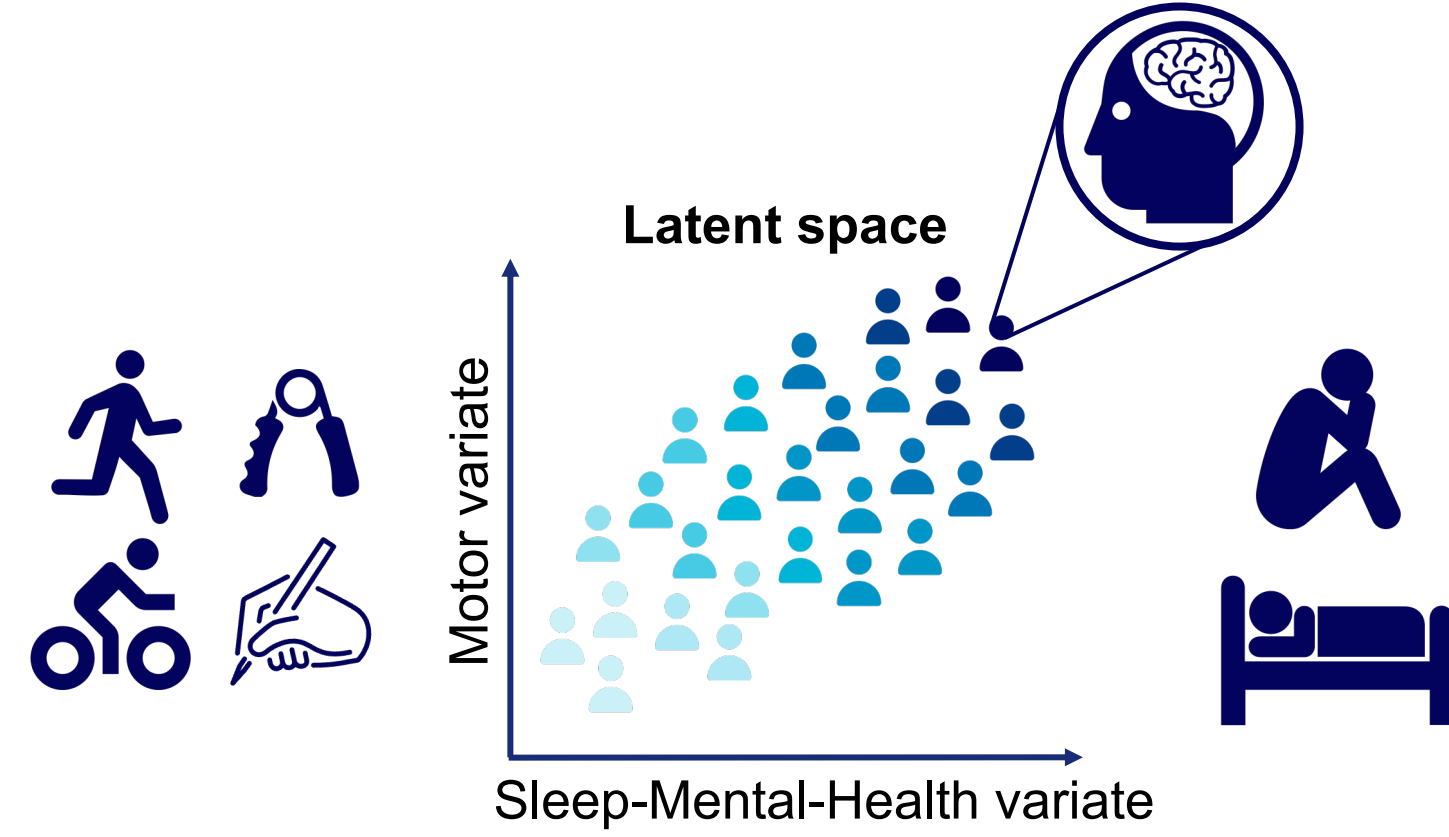
# Motor phenotypes: Multivariate associations with sleep, mental health, and grey matter volume

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## Background

- Higher levels of physical activity and motor performance are associated with better sleep health/mental health [1], [2]
- Impairments in all these domains, co-occur in neurodegenerative diseases like PD and AD
- Sleep pattern, mental health symptoms, physical activity and motor performance altered in older adults



## Research aims

- Identifying **multivariate associations** between sleep/mental health and motor behaviour in **older adults**.
- Predicting** individual motor-sleep-mental-health dimensions from neuroanatomical information

## Aim 1: Multivariate associations

### Sample: UK Biobank

n=17,979 (avg. 55.5 years, 40-70 y, 50% females)

#### Outer split (5 repeats)

20% Hold-out-set

#### Inner split (5 repeats)

Hyperparameter tuning

64% Training-set

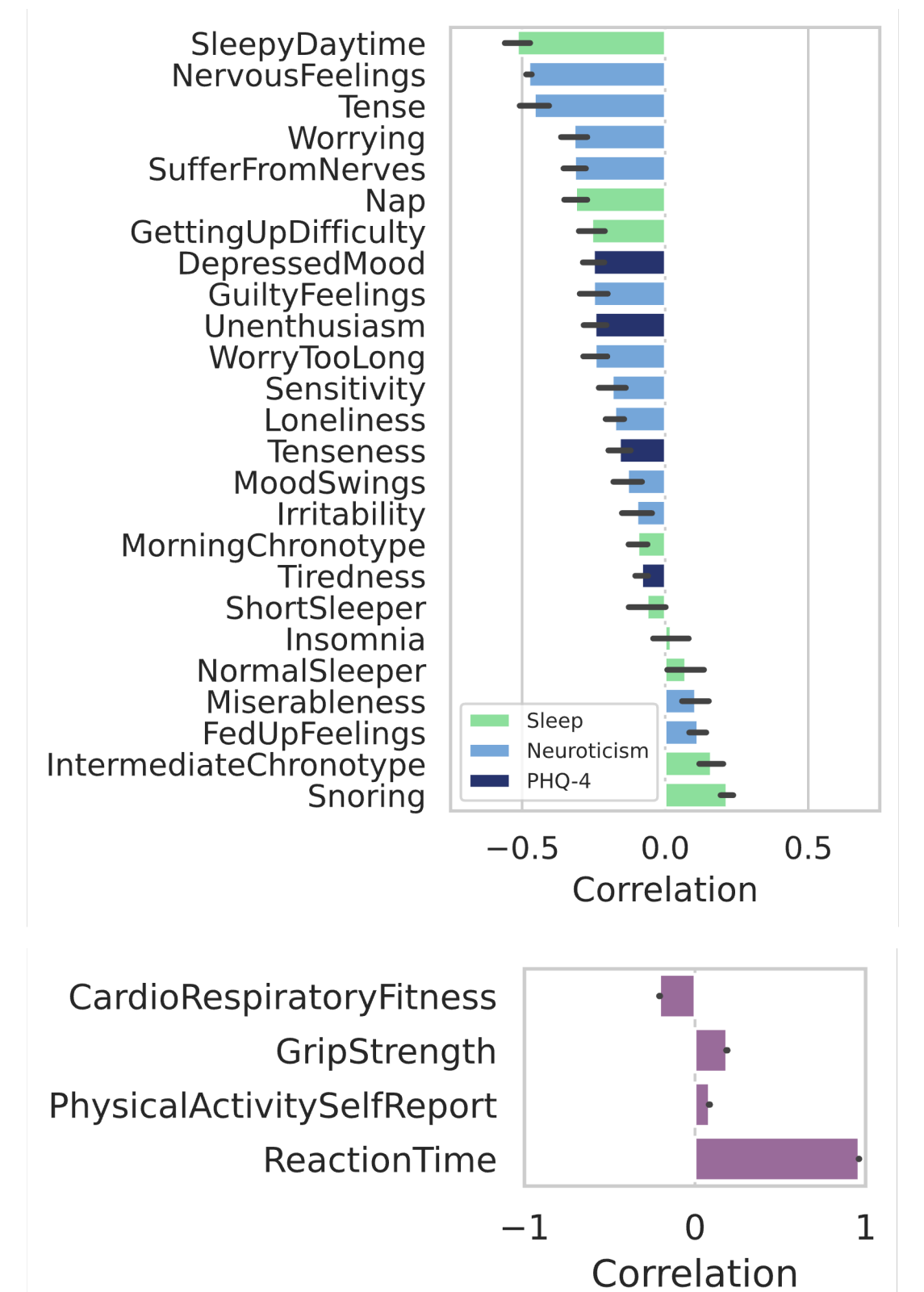
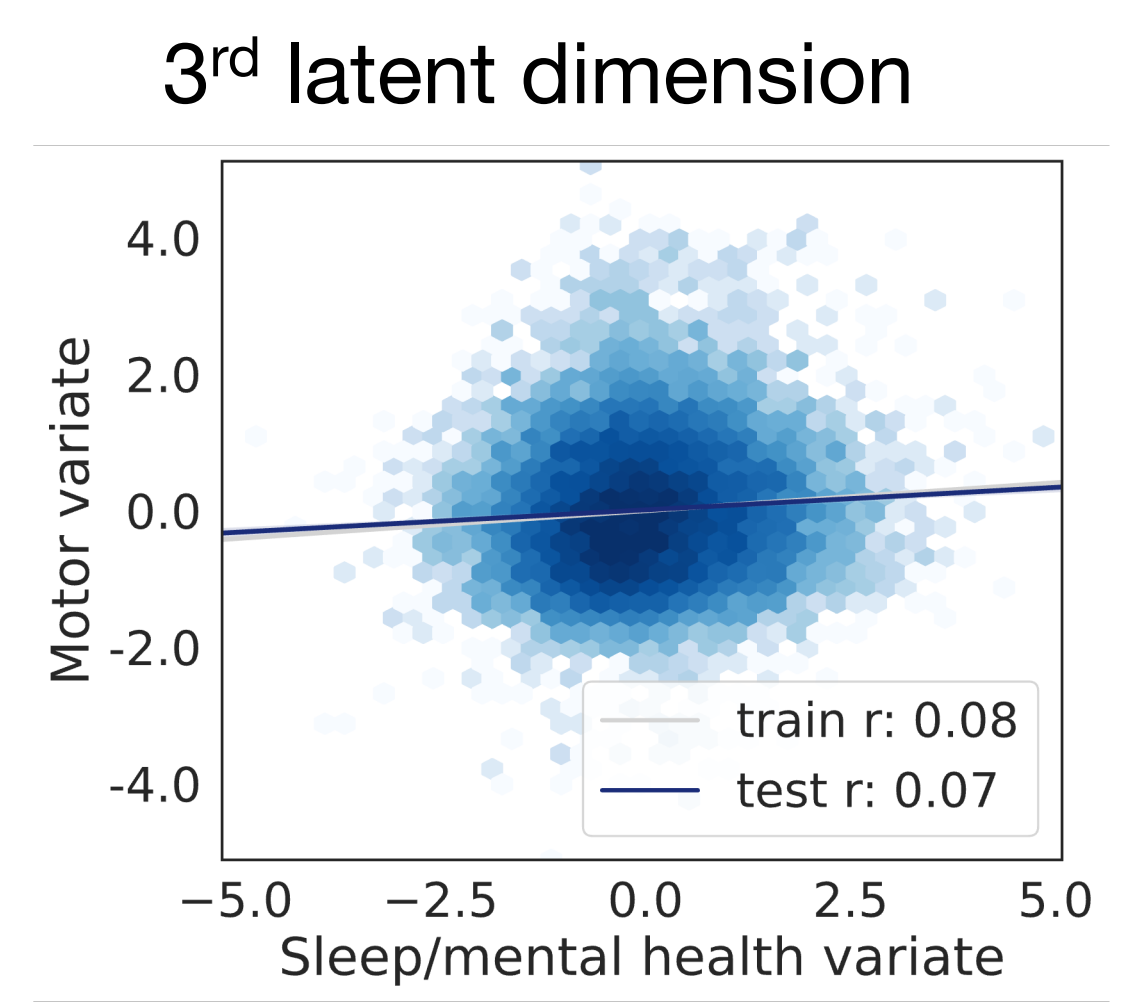
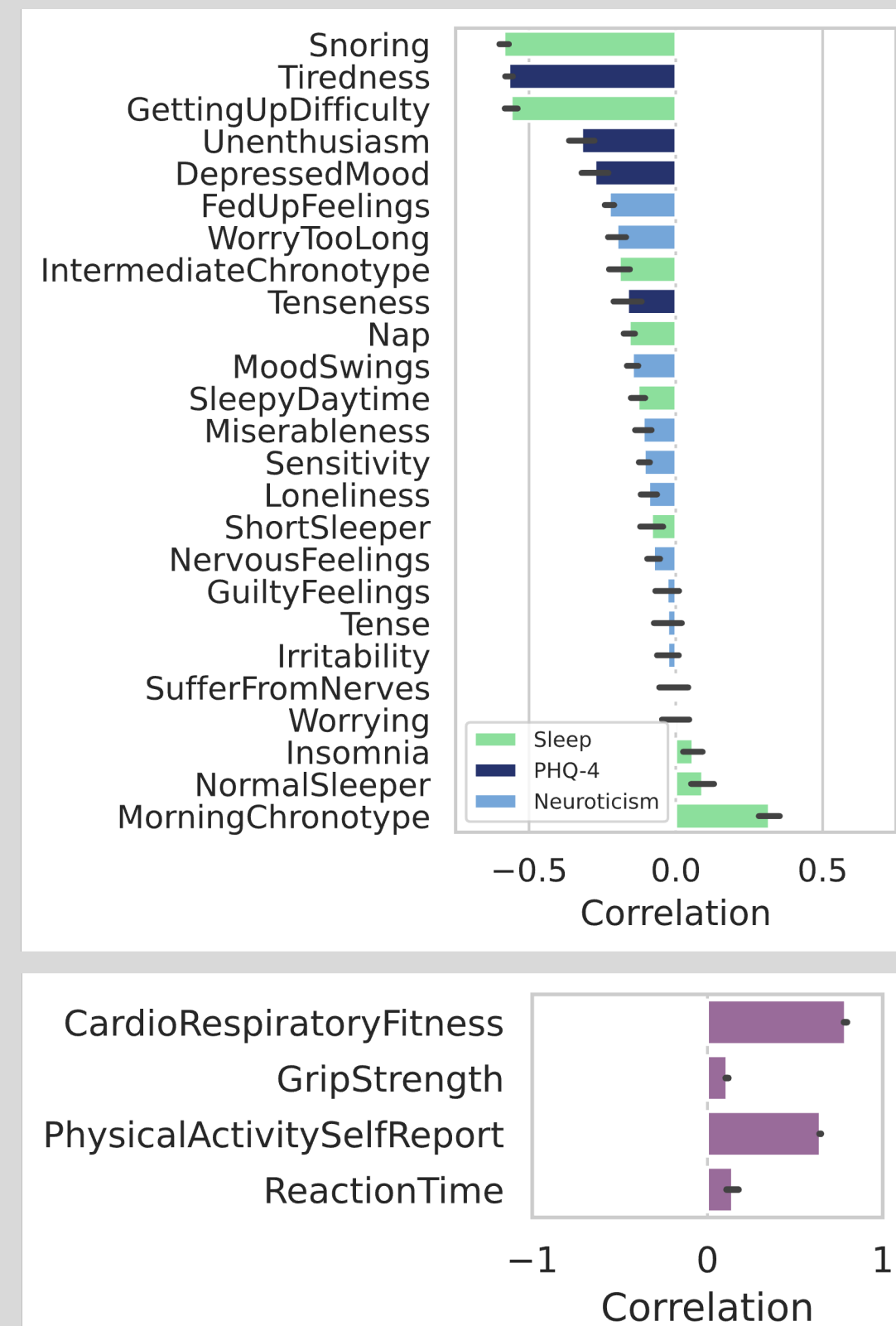
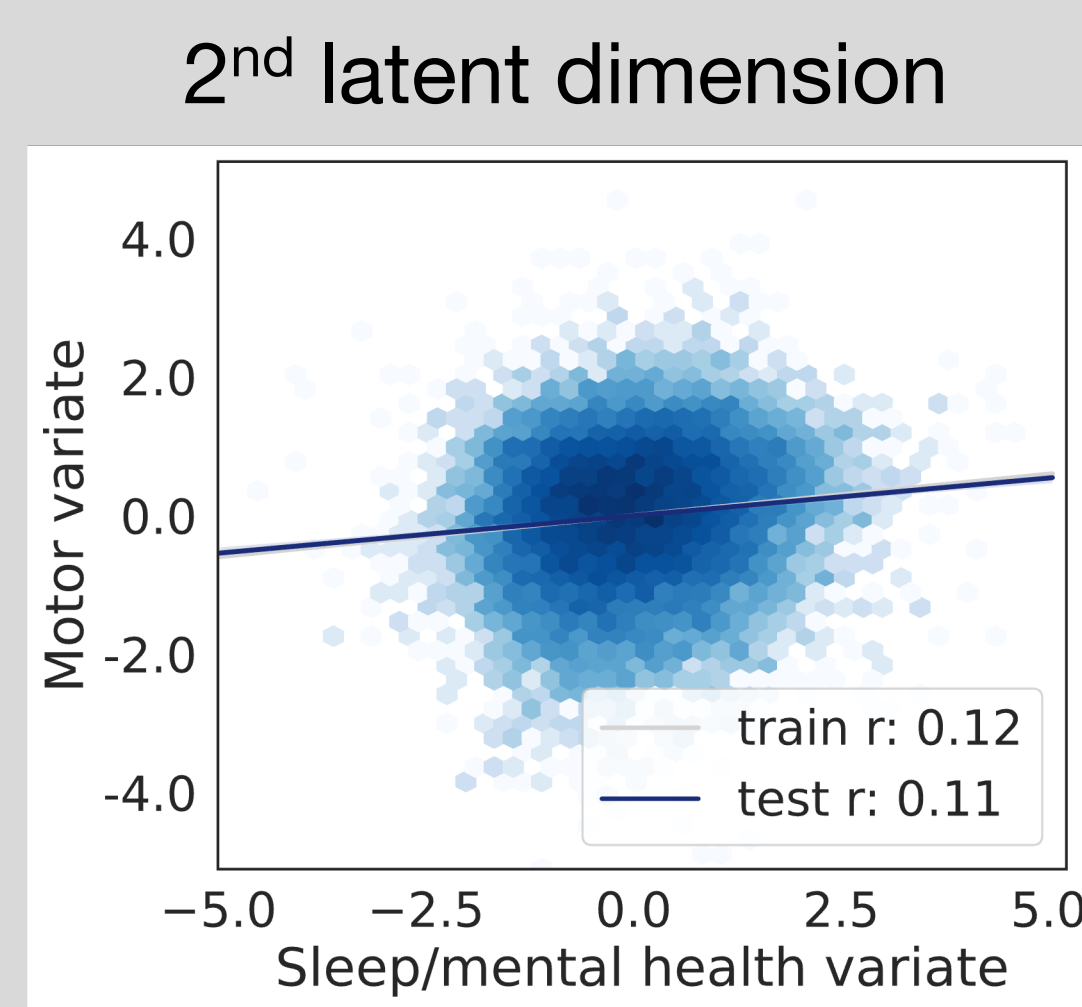
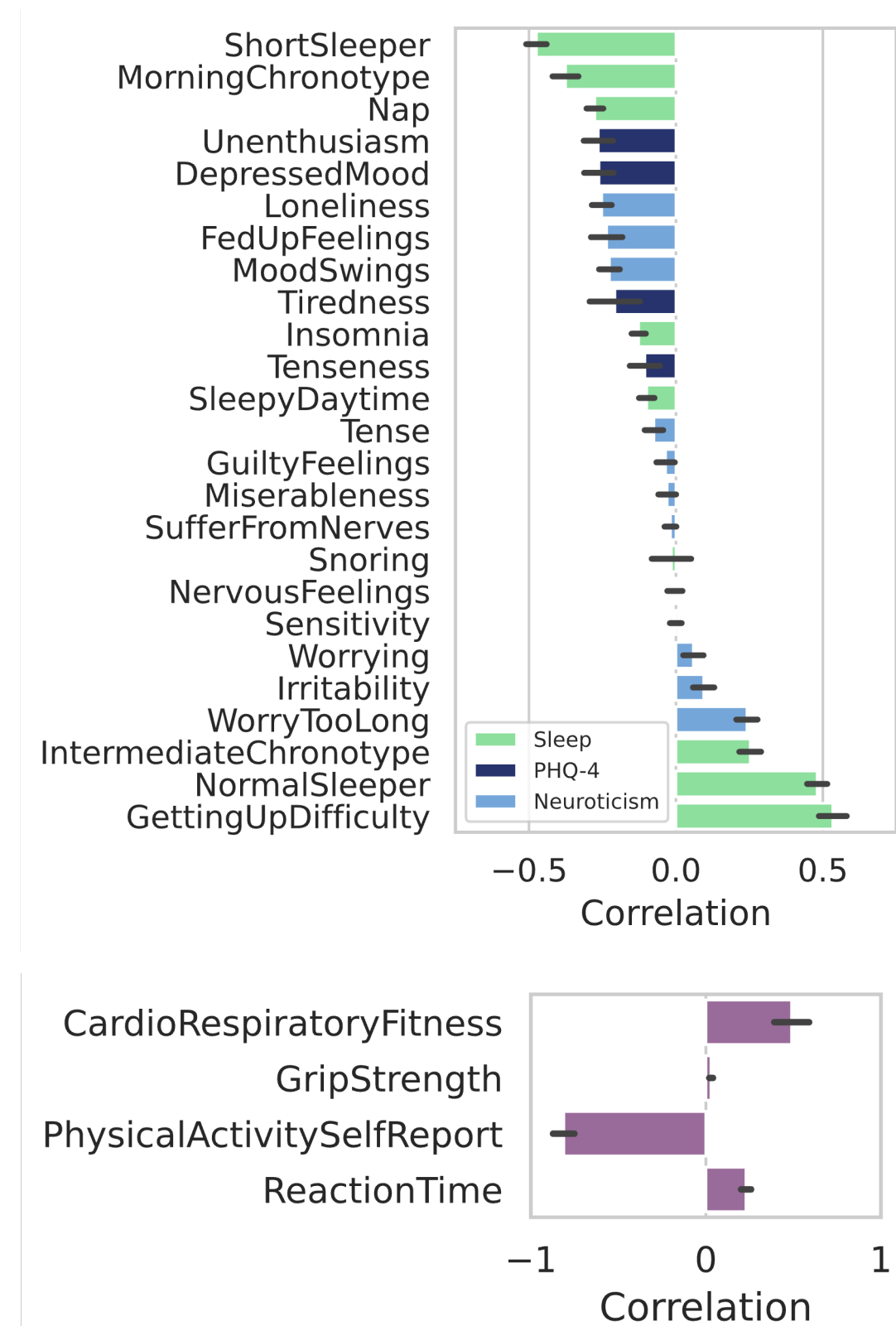
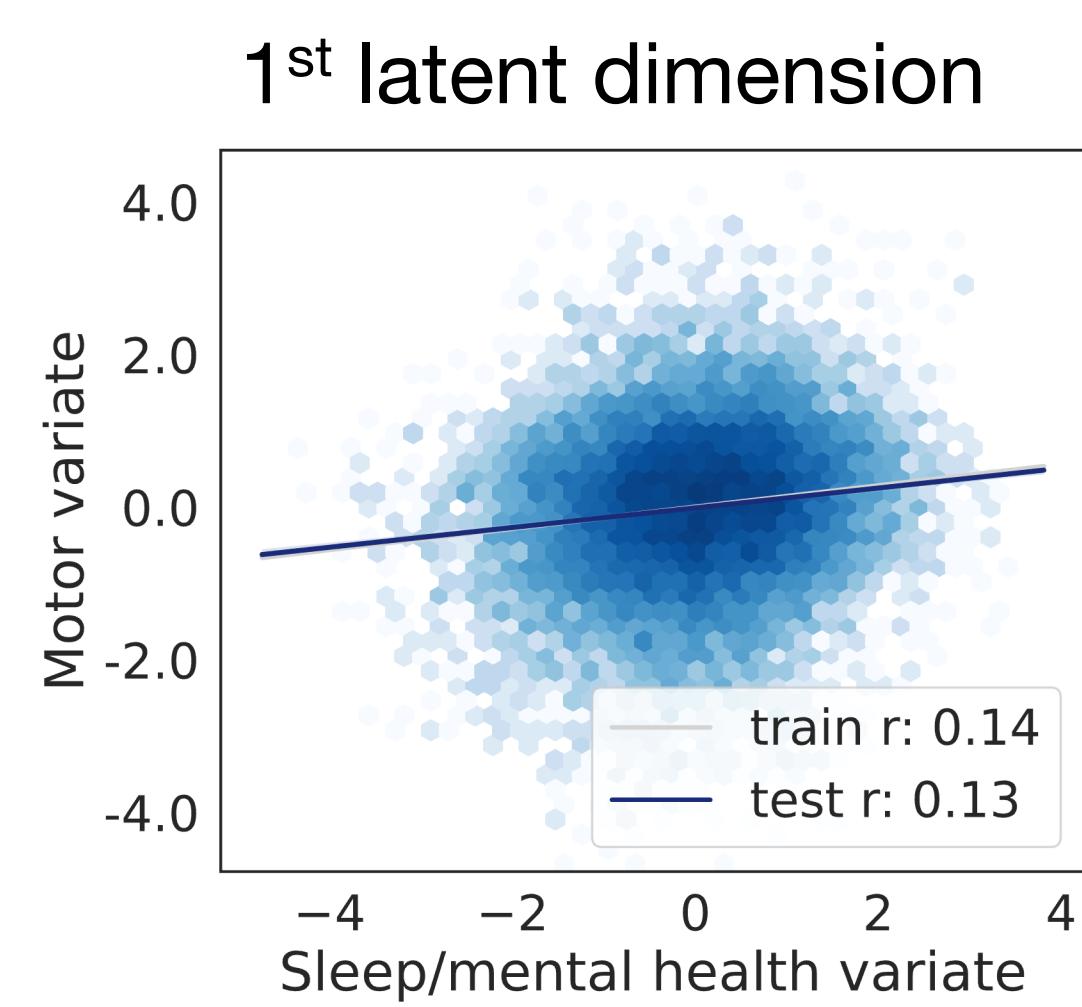
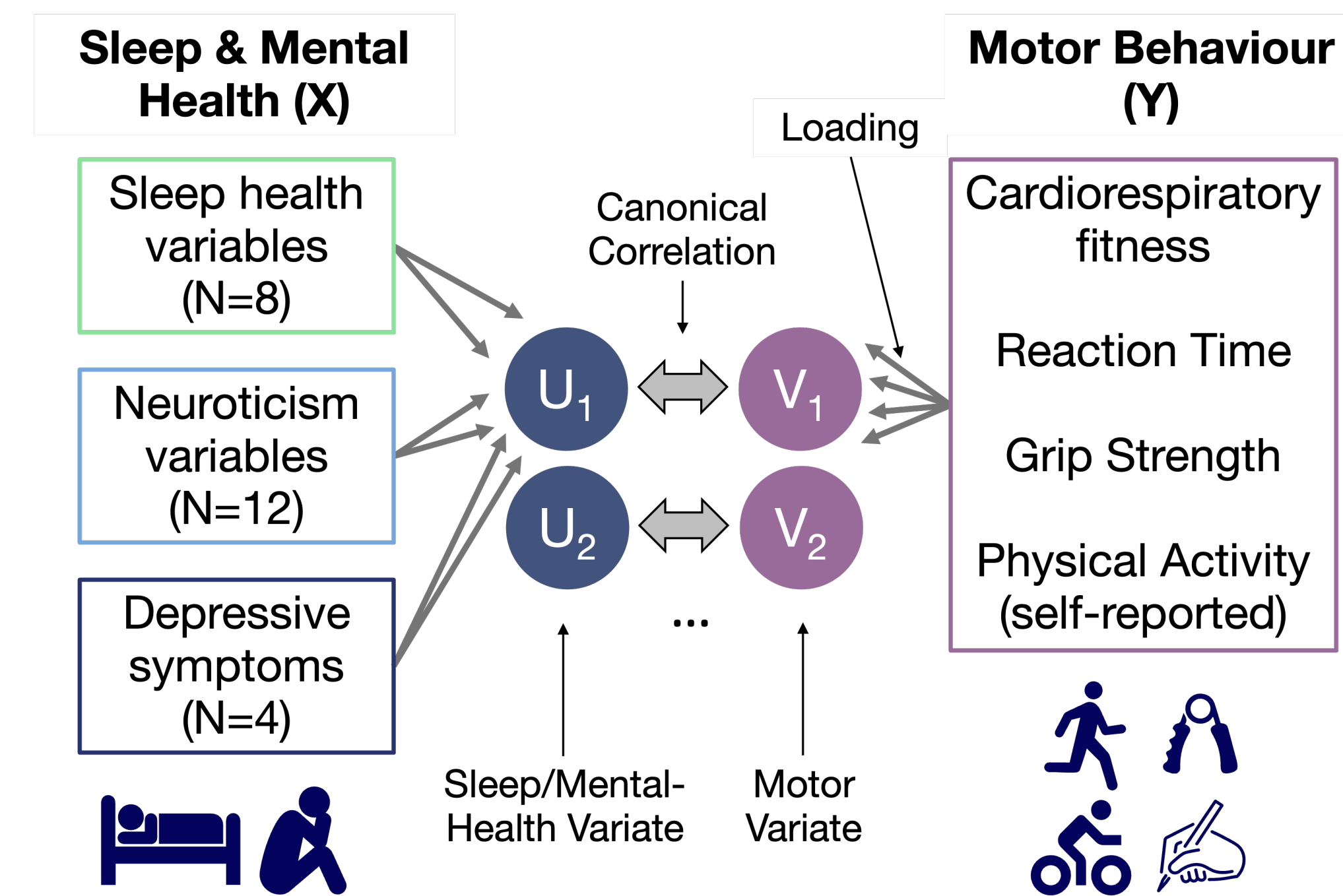
16% Test-set

**Statistical significance testing:**  
Permutation Test (1000 repeats)

### Replication sample (n=3,628) (avg. 60.8 y, 44-79 y, 48% f)

### Analysis:

Regularized Canonical Correlation Analysis (rCCA) [3]



Significant in replication sample

Bar plots show loadings (correlation of canonical variate with input variables) averaged over 5 outer repeats

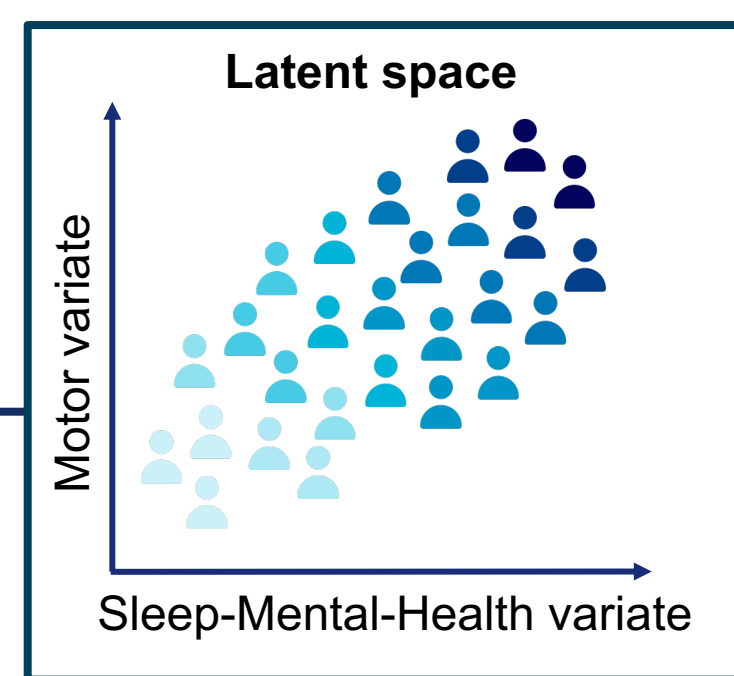
## Aim 2: Predicting individual motor variates

### Sample: UK Biobank (imaging session)

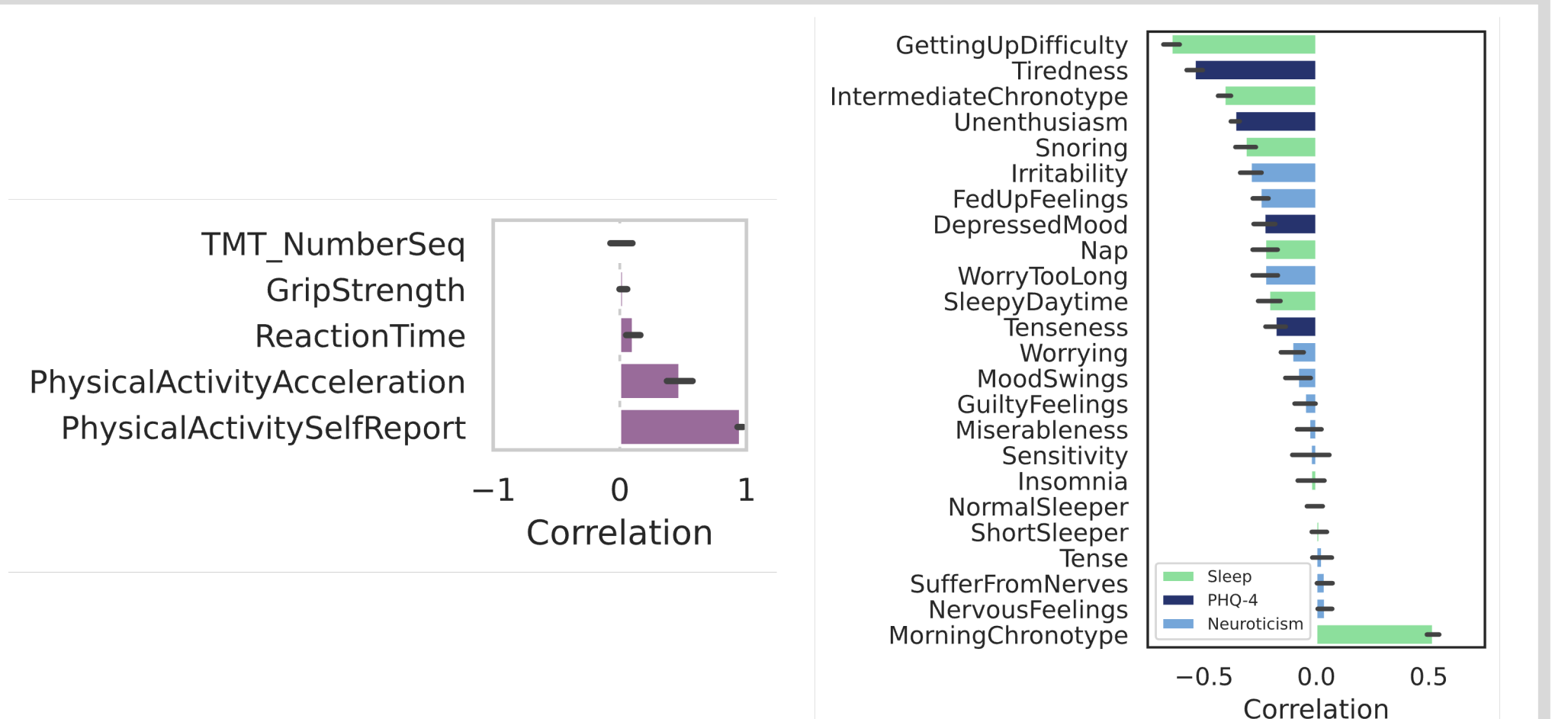
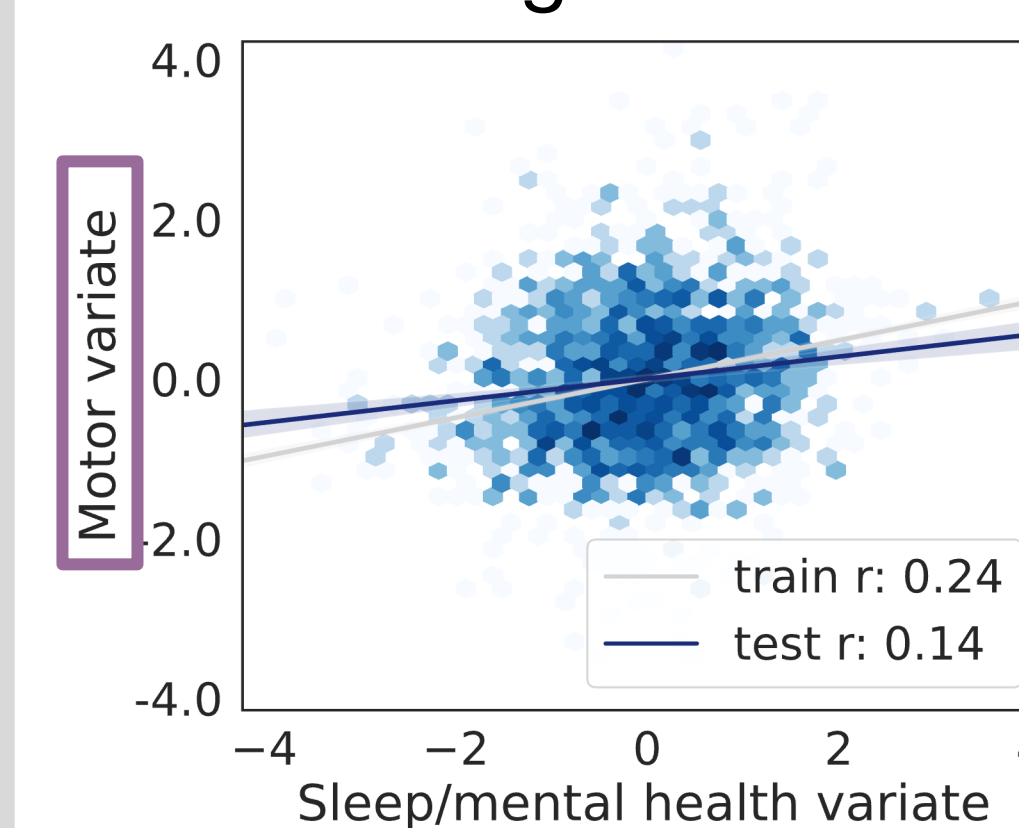
n=5,853

n=1,806 (avg. 65.9 years, 48-83 y, 47% females)

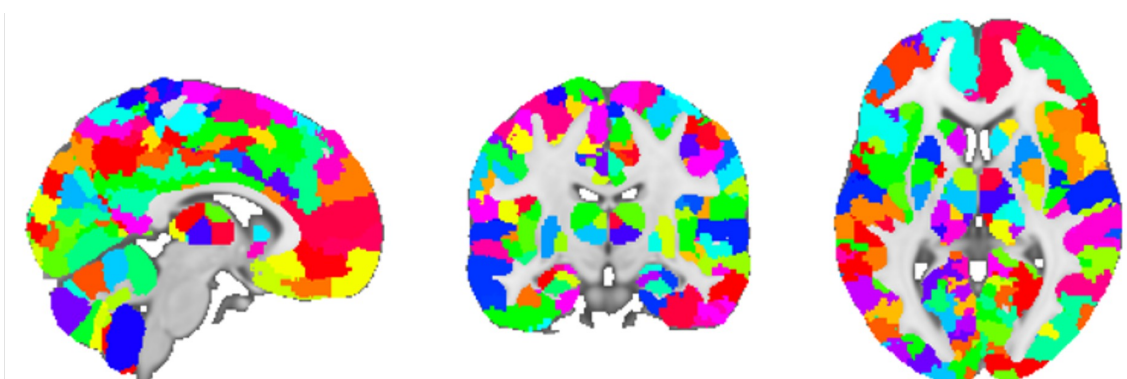
n=4,047 (avg. 63.2 years, 47-82 y, 51% females)



### rCCA for target definition



### Predictive analysis (XGBoost)



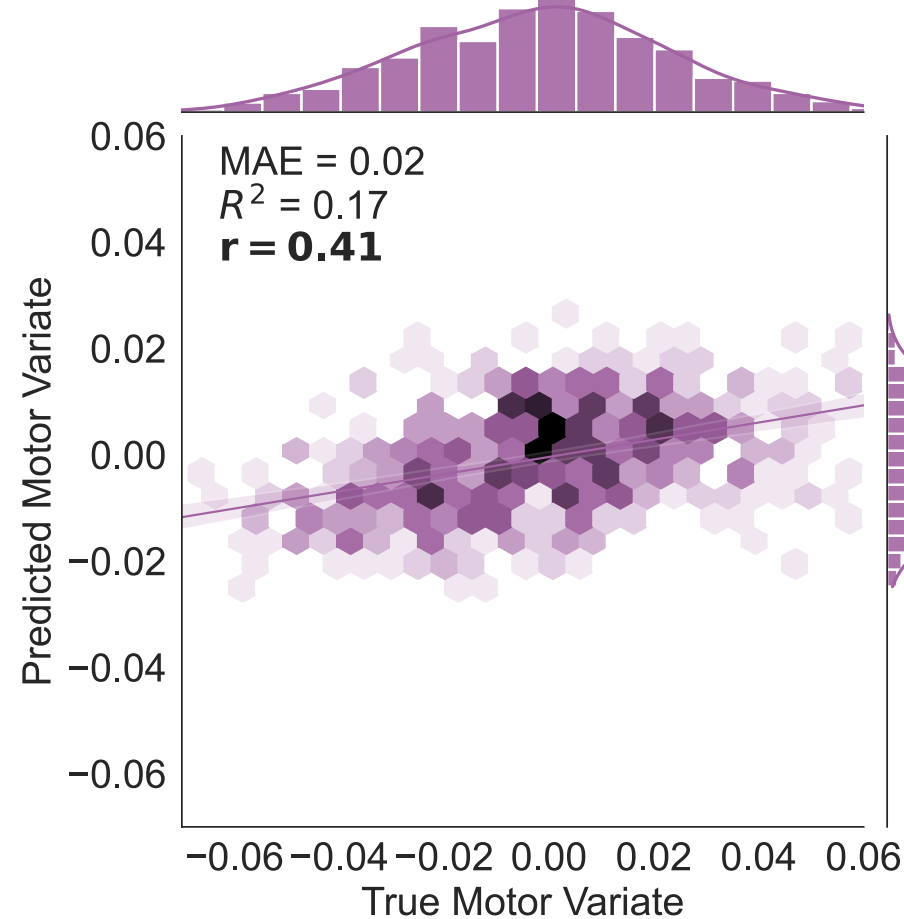
**GMV** (computed with CAT12)

- Schaefer 1000 ROIs
- Tian S4 54 ROIs
- SUIT cerebellar MNI 34 ROIs

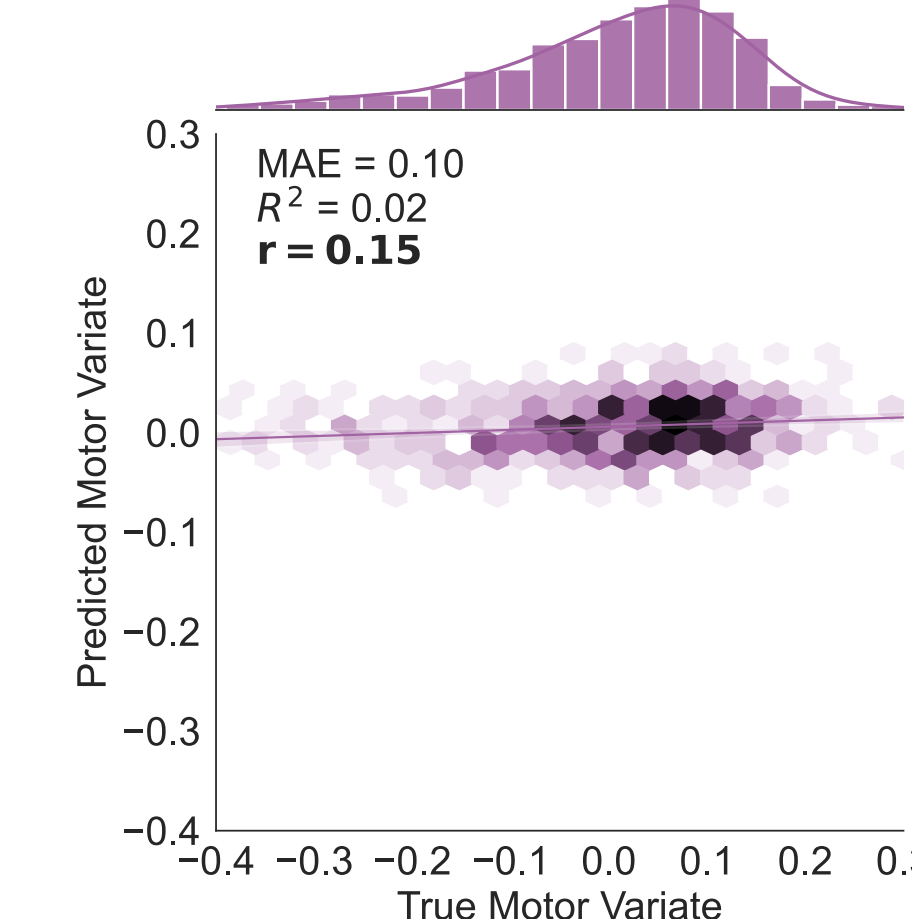
**Machine learning framework**

- 80/20 train/test split
- Train: Nested 5-fold CV
- Final model: out-of-sample predictions on test

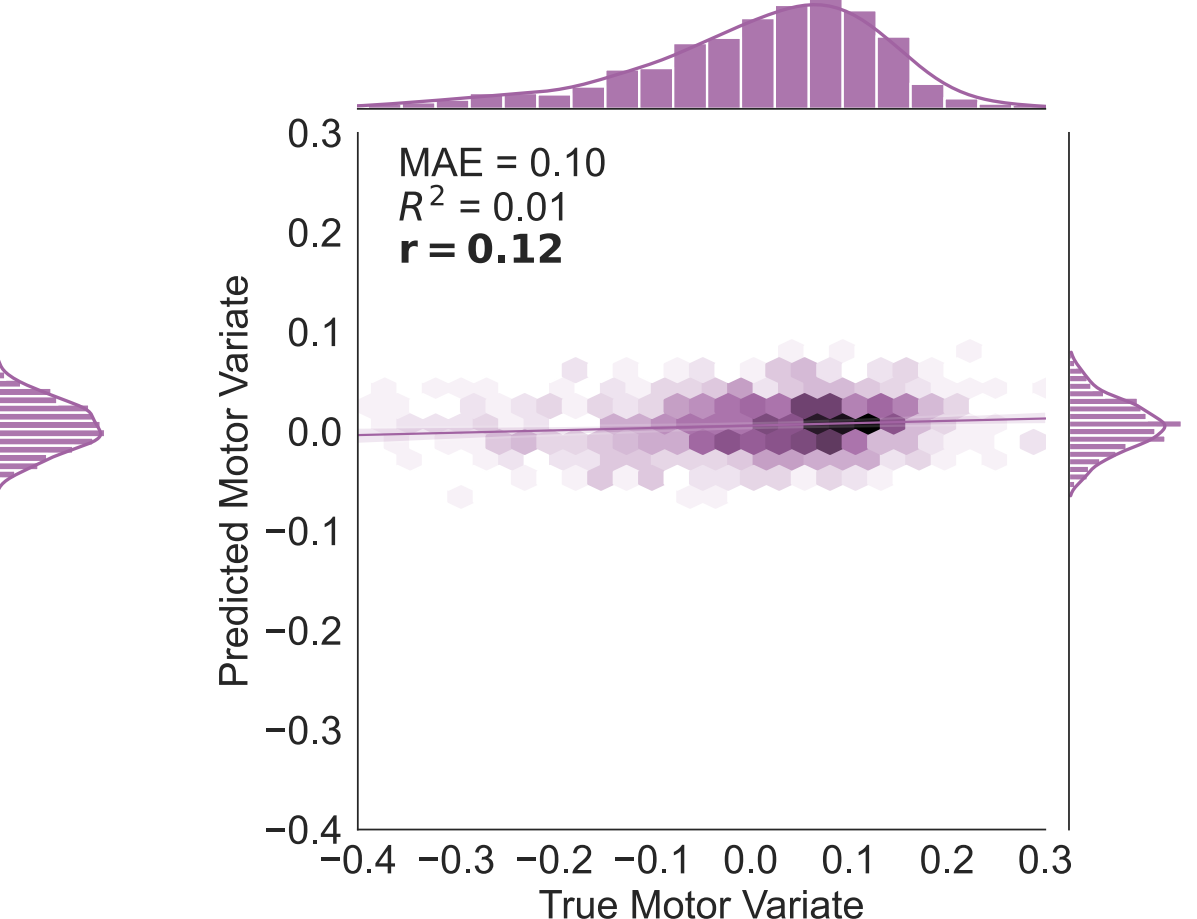
### No adjustment for age, sex



### Age, sex adjusted at CCA level



### Age, sex adj. at CCA/ XGBoost level



## Conclusions

- Robust multivariate links between motor behaviour and sleep/mental health
- 1<sup>st</sup> latent dimension: Reported physical activity and cardiorespiratory fitness differentially linked to sleep/mental health.
- Replicable 2<sup>nd</sup> latent dimension: Higher physical fitness associated with better sleep/mental health
- 3<sup>rd</sup> latent dimension: Higher reaction time related to lower neuroticism, less depressive symptoms, and better sleep health.
- Weak prediction of motor phenotype based on GMV
- Highlights importance of age and sex as potential confounders
- Potential of brain-behaviour prediction based on bio-/psychologically informed phenotypes

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**References** [1] Atoui et al., Sleep Medicine Reviews, 2021, [2] Singh et al., Br J Sports Med, 2023, [3] Mihalik et al., Biological Psychiatry: Cognitive Neuroscience and Neuroimaging, 2022.

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