

Is brain neurodynamics tied to self-control?



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Introduction

Strelau's Regulative Theory of Temperament (RTT) specifies temperament traits as basic features of personality determined by genetic factors that undergo environmental influences. Intensification of particular temperamental traits influences ones cortical arousal and activity.

Complexity of the electroencephalographic (EEG) signal reflects the amount of independently processing bioelectrical generators, i.e. neuronal circuits, which underlay observed EEG activity.

Eestimating complexity of EEG signal in absence of task (resting-state) can be used as a psychobiological marker compatible with the RTT when studying individual differences in tonic cortical arousal.

Moreover, studies conducted on twins show that characteristics of complexity of the neurodynamics are highly genetically determined

Aim of the study

Investigate relationship between EEG resting-state complexity and RTT temperament traits.

Methodology

Participants:

N = 28 (F = 19, 65.5%), age 19-31 (M = 21.7, SD = 2.9)

Temperament and EEG measurements

Formal Characteristics of Behavior – Temperament Inventory Modified

5 minutes long EEG resting-state activity recorded with 64-channelled, 10-20 EEG System.

Higuchi's Fractal Dimension and the brain

Higuchi's fractal dimension (HFD) analysis of the EEG signal measures the complexity directly in the time domain. HFD is particularly sensitive to small signal fluctuations, which occur as a consequence of bioelectrical synchronization changes in the brain. Due to latter, HFD is widely used as a tool for estimation of brain functions dynamics and its complexity.

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Results

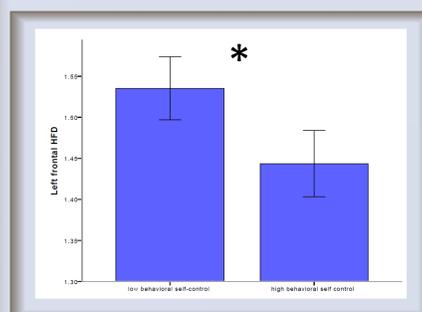


Fig. 1. T-test for left frontal HFD for low and high behavioral self-control groups. $p=.002$

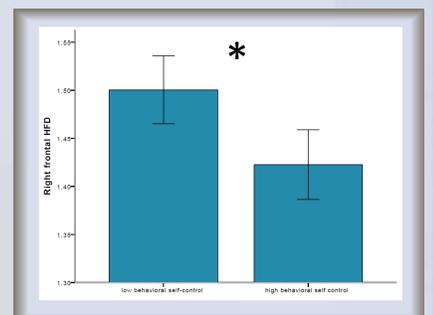


Fig. 2. T-test for right frontal HFD for low and high behavioral self-control groups. $p=.003$.

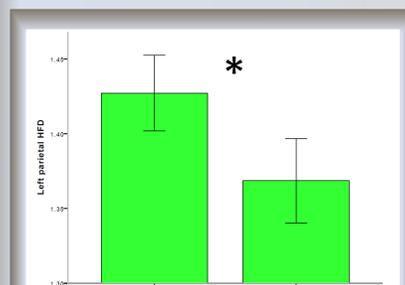
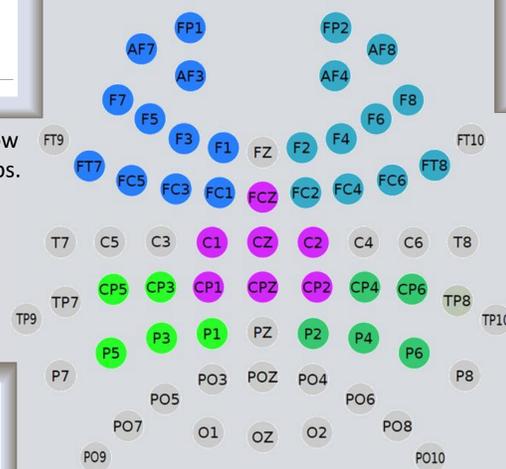


Fig. 3. T-test for left parietal HFD for low and high behavioral self-control groups. $p=.003$ and correlation between left parietal HFD measure and behavioral self-control. $R = -0.477^*$, $p = 0.012$.

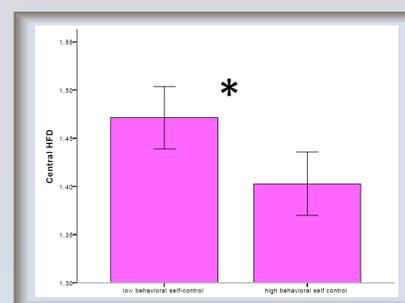


Fig. 5. T-test for central HFD for low and high behavioral self-control groups. $p=.004$.

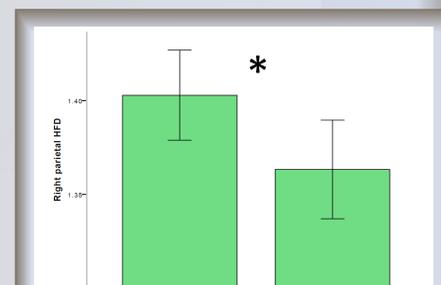
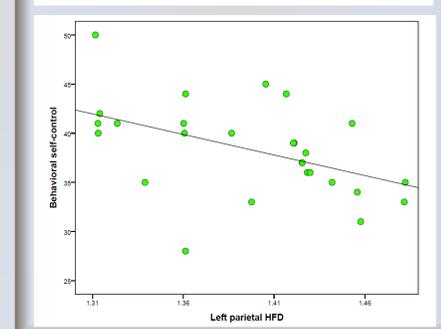
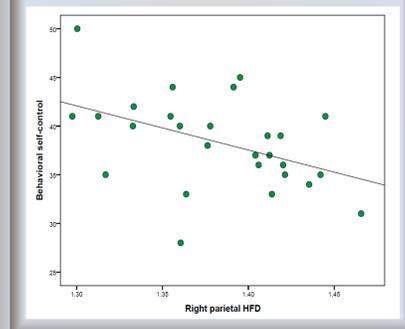


Fig. 4. T-test for right parietal HFD for low and high behavioral self-control groups. $p=.024$ and correlation between right parietal HFD measure and behavioral self-control. $R = -0.448^*$, $p = 0.019$.



Conclusions

- Behavioral self-control is only temperament trait which is related to EEG resting-state complexity.
- Correlation between behavioral self-control is observed in left and right parietal region.
- Participants with higher behavioral self-control are characterized by lower HFD measure in all regions examined in this study.
- Among 5 temperament traits in RTT behavioral self-control is crucial for effective, intentionally driven, behavioral inhibition for avoiding consequences of inappropriate behavior. Therefore participants in high behavioral self-control group are less likely to manifest compulsive behavior.
- Results presented above also shows that EEG resting-state complexity can be considered as novel correlate of temperament trait.

Literature

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