# Intrasubject Neural Variability and ADHD Symptomatology

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## Background

- Increased intrasubject variability (ISV) of reaction time refers to inconsistency in an individual's speed of responding to a task. This increased variability has been suggested as a fundamental feature of attention deficit hyperactivity disorder (ADHD), that is independent of other cognitive domains; however, its neural source is still unclear.
- In this study, we examined trial-by-trial EEG response variability to visual stimuli in order to explore the neural sources of ISV during visual perception process.

## Method

- 62 male adolescents (*M* = 17.36 years, *SD* = 0.41) who have been followed since birth as part of a prospective longitudinal study about ADHD's developmental pathways.

### ADHD Symptomatology Assessment

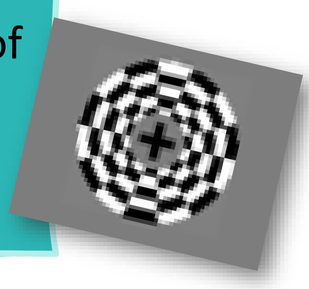
The Conners' Rating Scales-Revised (CRS-R) (Conners, 1997)

Mothers completed the questionary regarding their sons (Cronbach's alpha > .81).

### Visual Sensory Task

(Gonen-Yaacovi et al., 2016)

In this task, the target stimulus appeared in 2/3 of the trials. The experiment included a color-detection task at fixation, which intended to preserve the subjects' attention.



### Trial-by-Trial Variability

Neural trial-by trial mean variability was calculated at the following time periods:

**Pre-stimulus**

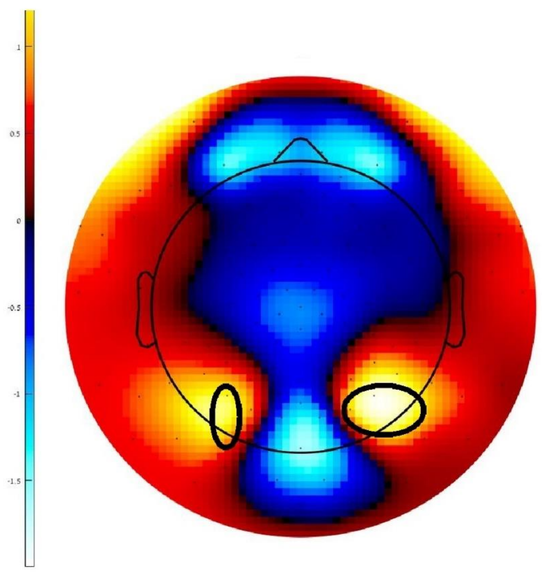
**(before stimulus presentation)**

-200-0 ms

**Post-stimulus**

**(after mean P100 response)**

110-400 ms

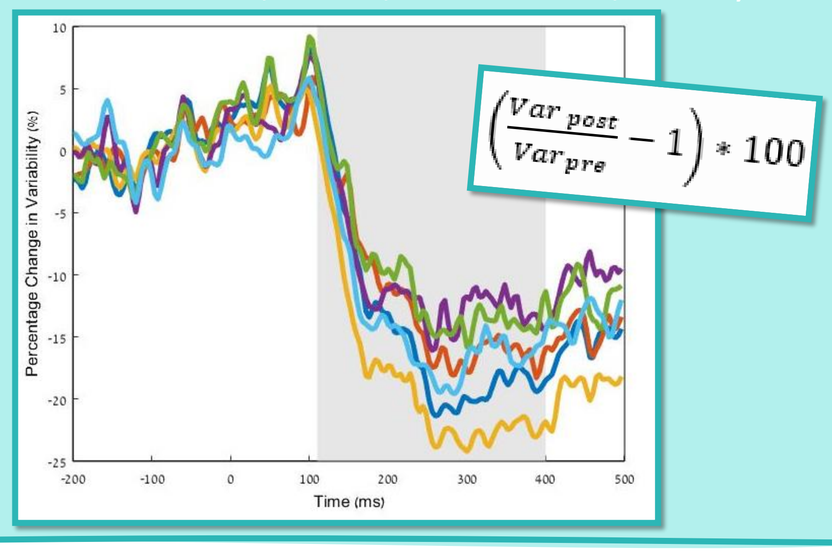


Topographic map of voltages on the scalp at the P100 time window. The chosen electrodes for analyses are marked within the ellipses.

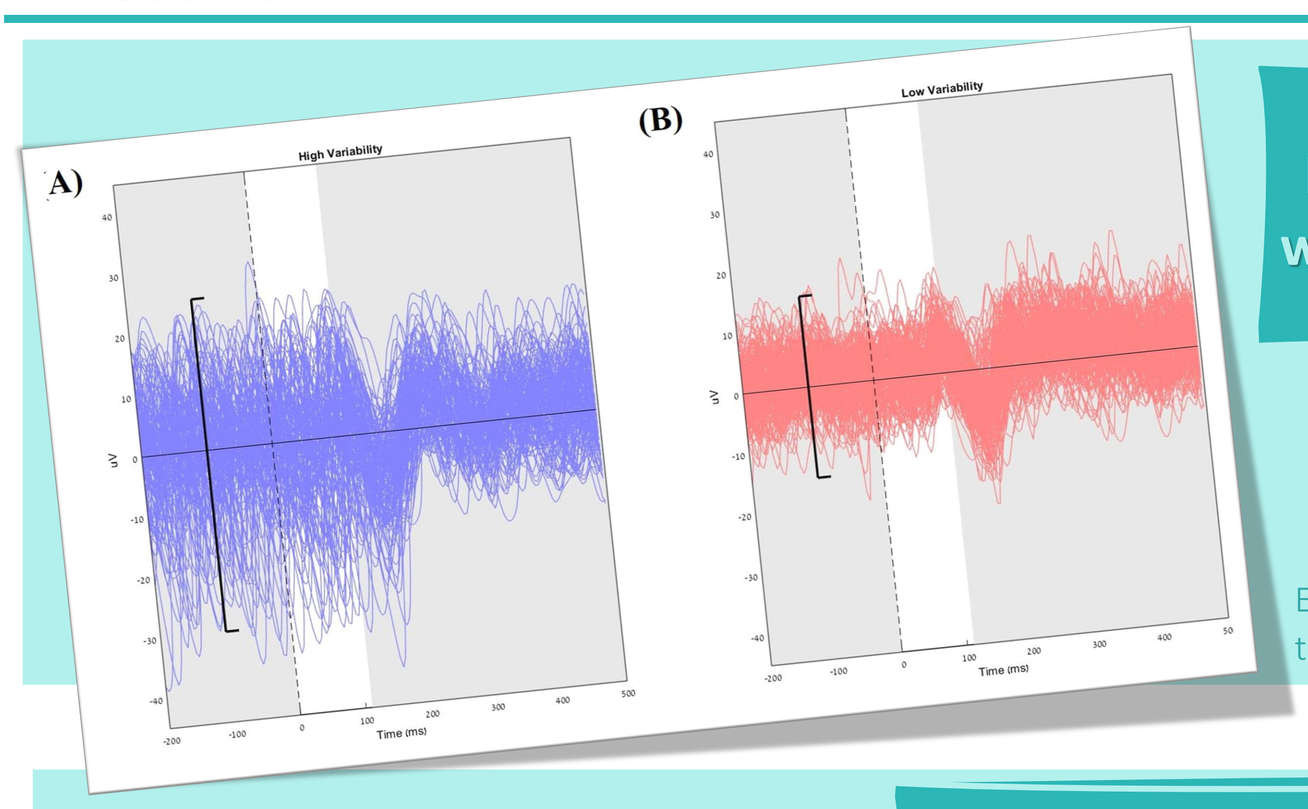
### Quenching

Quenching is a phenomenon in which neural variability response across trials is larger before the stimulus presentation and significantly reduced afterwards. The value of this measure represents the percentage of change in variance between the two time periods.

(Churchland et al., 2010; Arazi et al., 2017)




## Results



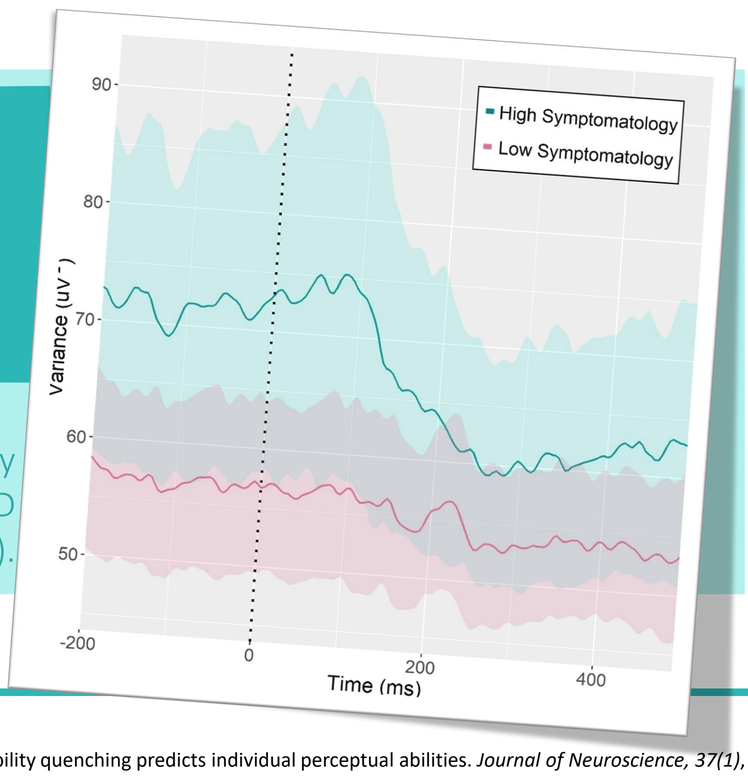

### Higher ADHD symptomatology was associated with larger neural ISV in the pre-stimulus period

| | | Pre-Stimulus | Post-Stimulus | Quenching |
|---|---|---|---|---|
| ADHD Symptomatology | Pearson's r | 0.265* | 0.157 | -0.269* |
| | P value | 0.041 | 0.230 | 0.037 |

Examples of trial-by-trial measured voltage across the chosen electrodes by time from 2 subjects with relatively high (A) or low (B) neural variability.

| | Predicting Quenching | |
|---|---|---|
| **Predictor** | **β** | **P value** |
| IQ | -0.159 | 0.241 |
| ADHD symptomatology | -0.299* | 0.030 |
| **$R^2$** | **0.117** | |

### Individuals with high ADHD symptomatology present larger quenching magnitude




Temporal dynamics of trial-by-trial amplitude variability over time and across subjects by low and high ADHD symptomatology groups (CI of 95%).

## Conclusions

These findings suggest that the ongoing neural activity of individuals with high ADHD symptomatology may be more variable; however, after perceiving a visual stimulus, such variability decreases to a larger extent, even to a level that is similar to the one in those with low symptomatology. Larger variability quenching among individuals with larger ongoing neural variability, such as individuals with ADHD, might reflect a compensation mechanism that enables "normative" visual processing.

## References

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