

# EXECUTIVE FUNCTIONS AND ERP BIOMARKERS IN CHILDREN AND ADOLESCENTS WITH ADHD AND AUTISM

Akademisk avhandling

Som för avläggande av medicine doktorsexamen vid Sahlgrenska akademien, Göteborgs universitet kommer att offentligens försvaras i hörsal Arvid Carlsson, Medicinaregatan 3, fredagen den 17 november klockan 13:00

av **Linda Angelica Häger Krabberød**

Fakultetsopponent:

**Docent Matti Cervin**, Lunds universitet, Sverige

## Avhandlingen baseras på följande delarbeten

I. Häger, L. A., Øgrim, G., Danielsen, M., Billstedt, E., Gillberg, C., & Johnels, J. Å. (2020). Indexing Executive Functions with Test Scores, Parent Ratings and ERPs: How Do the Measures Relate in Children versus Adolescents with ADHD? *Neuropsychiatric Disease and Treatment*, 16, 465.

II Häger, L. A., Johnels, J. Å., Kropotov, J. D., Weidle, B., Hollup, S., Zehentbauer, P. G. & Øgrim, G. (2021). Biomarker support for ADHD diagnosis based on Event-Related Potentials and scores from an attention test. *Psychiatry Research*, 300, 113879.

III. Häger L.A, Høyland Anne L. Kropotov J.D., Åsberg Johnels J., Weidle B., Hollup S., Øgrim G. (submitted 2023). Is visual prediction impaired in adolescents with autism spectrum disorder? Event-Related Potentials in a cued visual GO/NOGO task.

IV. Åsberg Johnels, J, Häger, L., Billstedt, E., Hagberg, B., Øgrim, G & Gillberg, C. (manuscript). Integrating psychoeducational and EEG-based data in neurodevelopmental assessment: Case study of a child with attentional, mathematical and nonverbal learning difficulties.

**SAHLGRENKA AKADEMIN**  
INSTITUTIONEN FÖR NEUROVETENSKAP OCH FYSIOLOGI



# Executive functions and ERP Biomarkers in children and adolescents with ADHD and Autism

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Executive Functions (EF) refers to skills that help us initiate, organize and evaluate activities. Problems with EF are associated with neurodevelopmental disorders such as Attention Deficit Hyperactivity Disorder (ADHD) and autism spectrum disorder (ASD). In the present project, we use parent ratings, scores from an attention test (a cued visual continuous performance test [VCPT]) and Event Related Potentials (ERPs) to examine EF. The **overarching aim** of this thesis has been to learn more about the underlying neurocognitive bases of ADHD, ASD, EF, and to explore the possibilities of using ERPs and VCPT scores as supplementary diagnostic tools. **In study 1**, we studied correlations of different measures of EF in 59 ADHD patients. We found that the correlations between the EF measures were different among children (9-12 years) and adolescents (13-17 years), indicating developmental dynamics. The overall conclusion of the study was that the different measures of EF are complementary, each contributing unique knowledge. **In study 2**, the goal was to develop and evaluate a diagnostic ADHD index by combining data from ERP assessments and scores from the VCPT. Initially, sixty-one children with ADHD and 69 “typically developing children” (TDC) participated. The calculated index discriminated between the ADHD and the TDC groups with a large effect size ( $d=1.47$ ). In a replication sample,  $d$  was 3.03. **In study 3**, we compared ERPs and test scores for 63 adolescents with ASD and 60 TDC. We found no significant group differences in behavioral test scores. However, several visual ERP components differed with largest difference seen in ERP component Visual Negativity (vN) which is assumed to reflect visual preparation. This finding is in accordance with theories claiming that predictive mechanisms are altered in ASD. **Study 4** was a comprehensive case study of a boy with ADHD, mathematical disability and nonverbal learning disability, illustrating how clinical information from several methods, including ERP-data, can be integrated. **In summary**, it is argued that ERPs can contribute to diagnostic conclusions and increased understanding of EF problems related to ADHD and ASD.

Keywords: Supplementary biomarkers, child psychiatry, ADHD, autism, executive function, neuropsychological tests, event related potentials, EEG

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