

# **Children and Adolescents with ADHD**

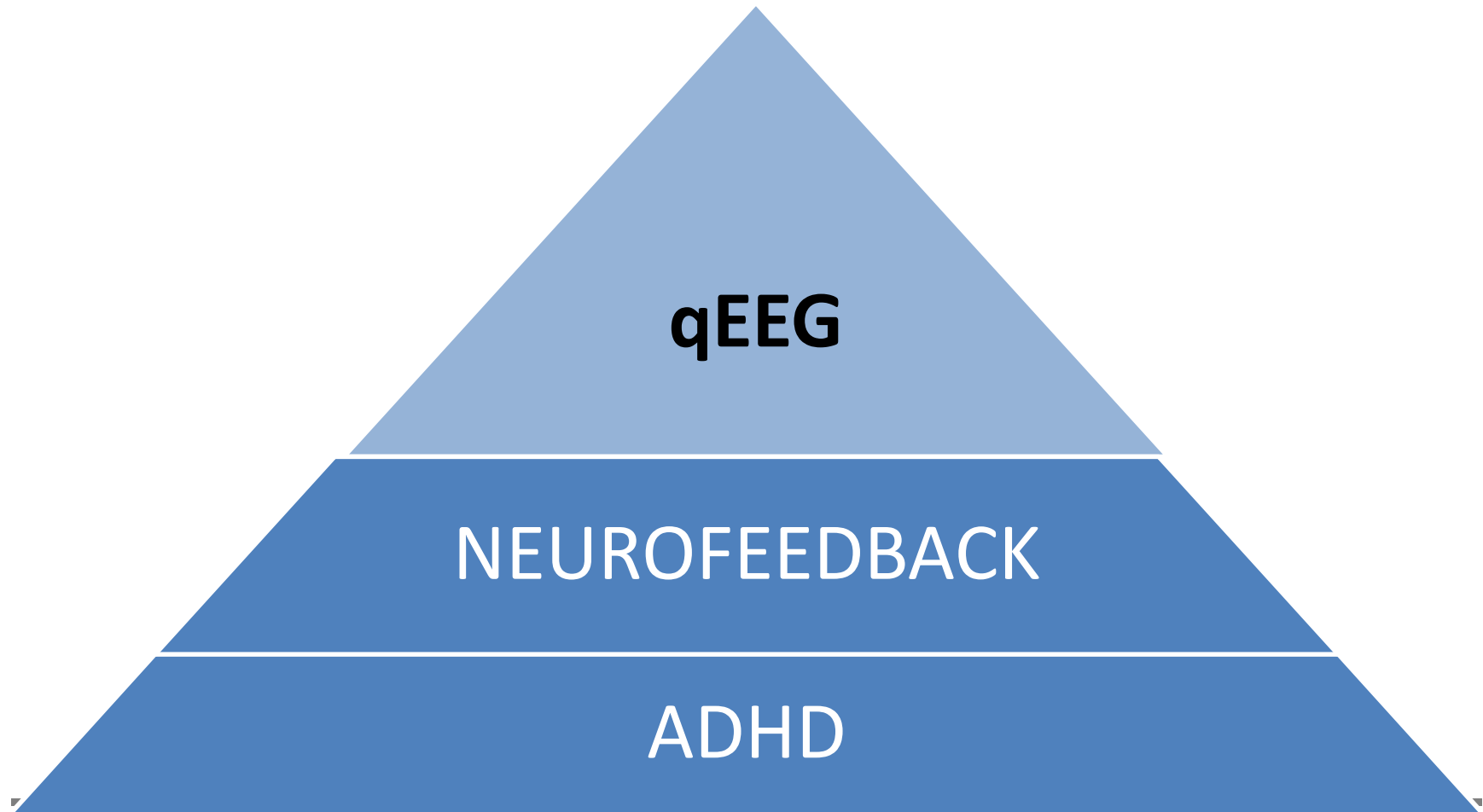
**Long-term randomized controlled  
study**

**Dr.Nezla S. Duric**

**Child and Adolescent Psychiatrist /PhD**

# Children and Adolescents with ADHD

3 steps



# ADHD Deficit of Self-Regulation

- ADHD-”problems “being secondary to inhibited impulse control and lack of self-regulation
- Leads to a lack of development of other specific and important psychological processes
- Also includes emotional dysregulation (Barkley)

ADHD patients do not lack knowledge or specific skills, but the ability to coordinate / use these appropriately

# ADHD Etiology

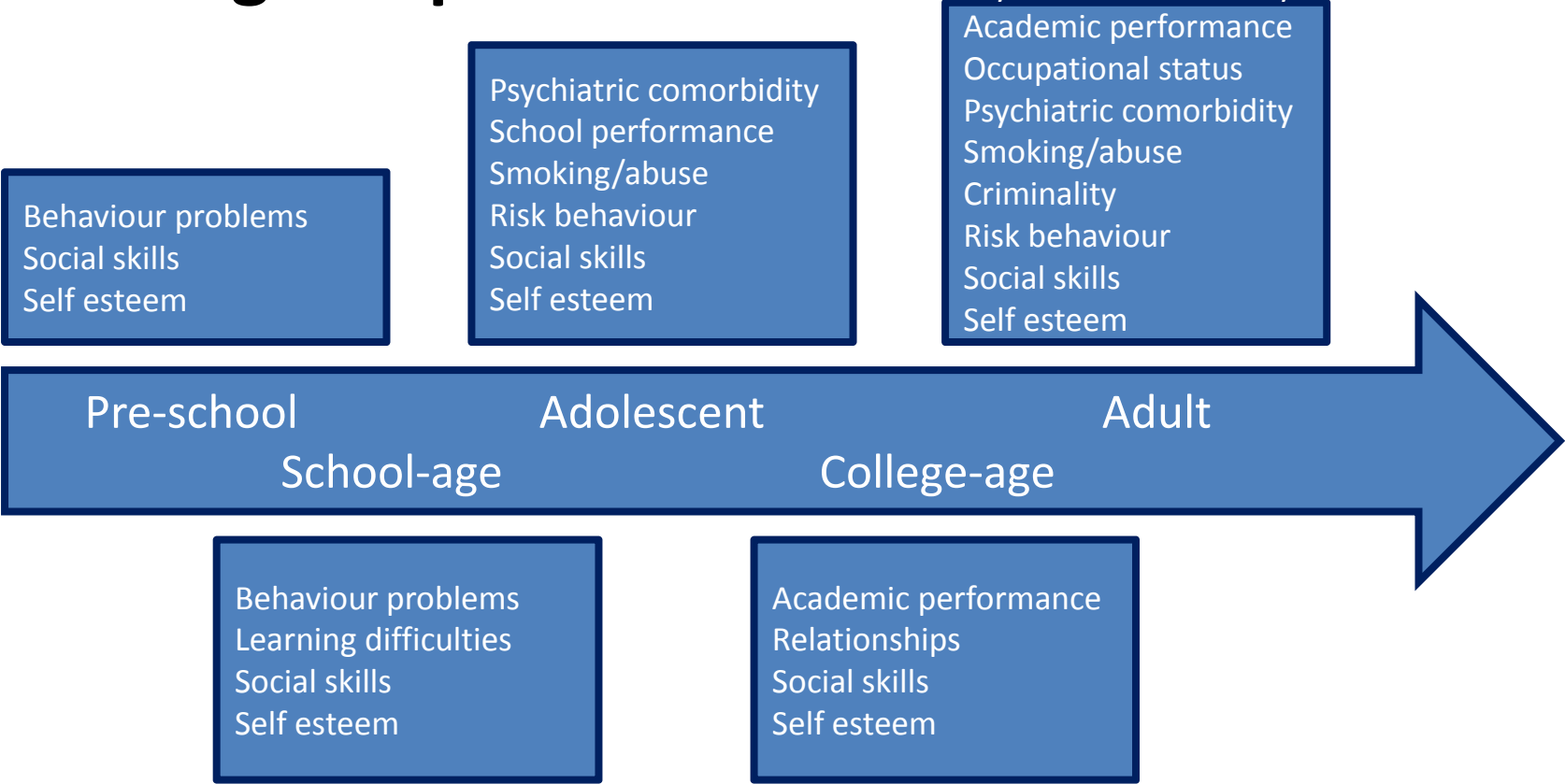
"The cause has been attributed to biofactors.  
The outcome has to do with how the child  
meets the environment and  
how the environment *meets the child*"

Professor Eric Taylor at the Institute of Psychiatry, Kings College in London

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# Characteristics of ADHD

## Lifelong Perspective

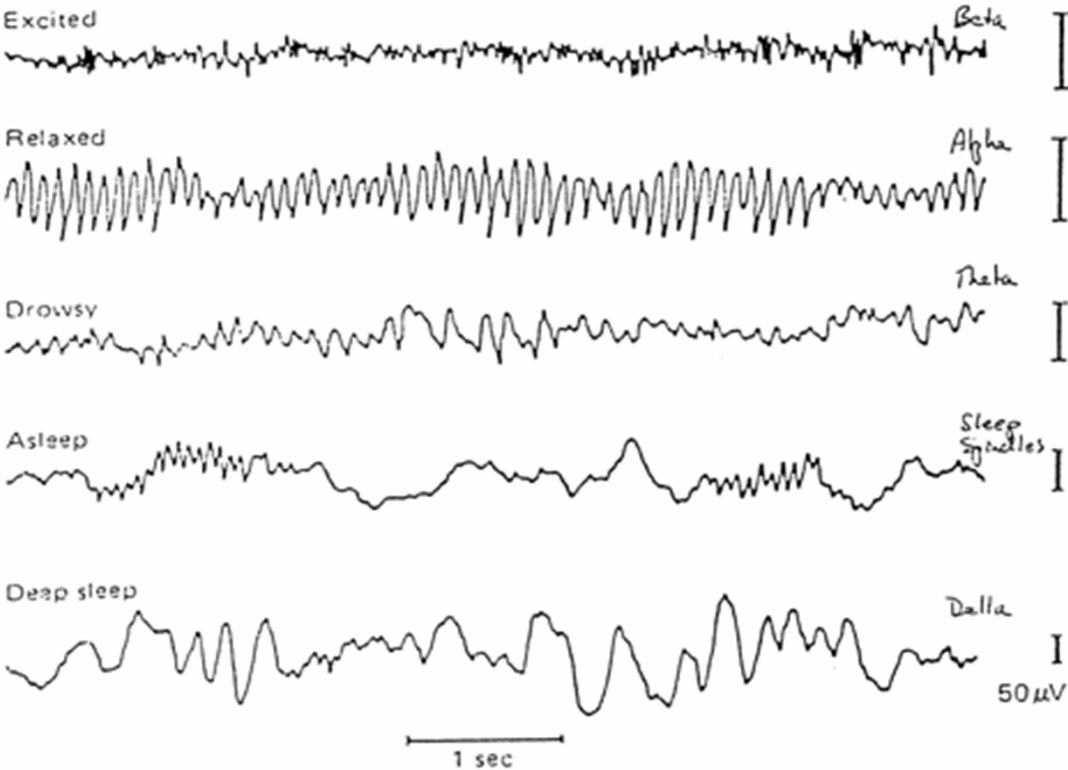
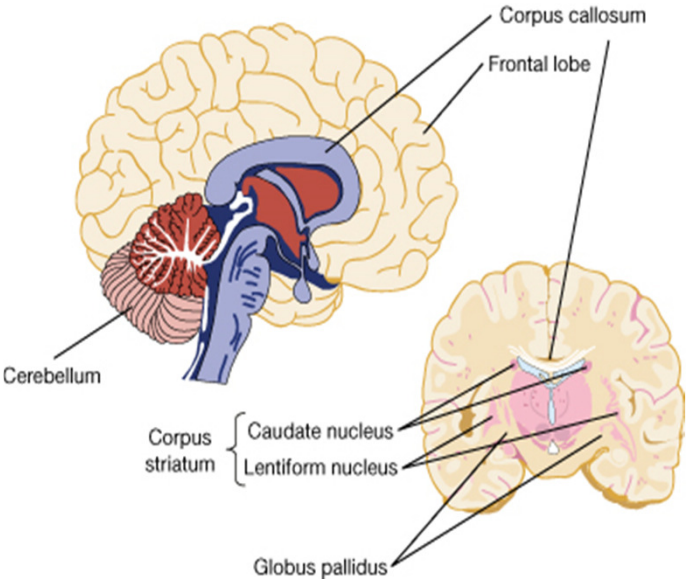


Halmøy et al, Journal of Attention Disorders, 2009

# ADHD patho-physiology

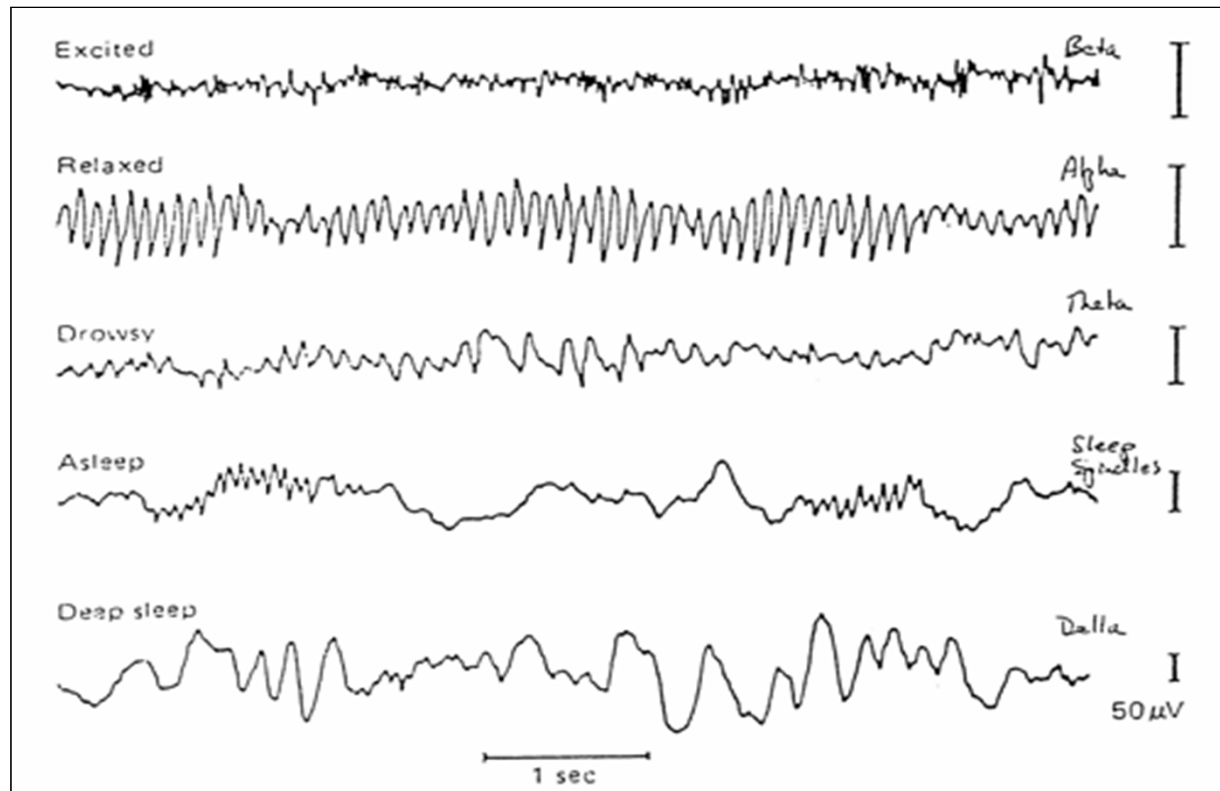
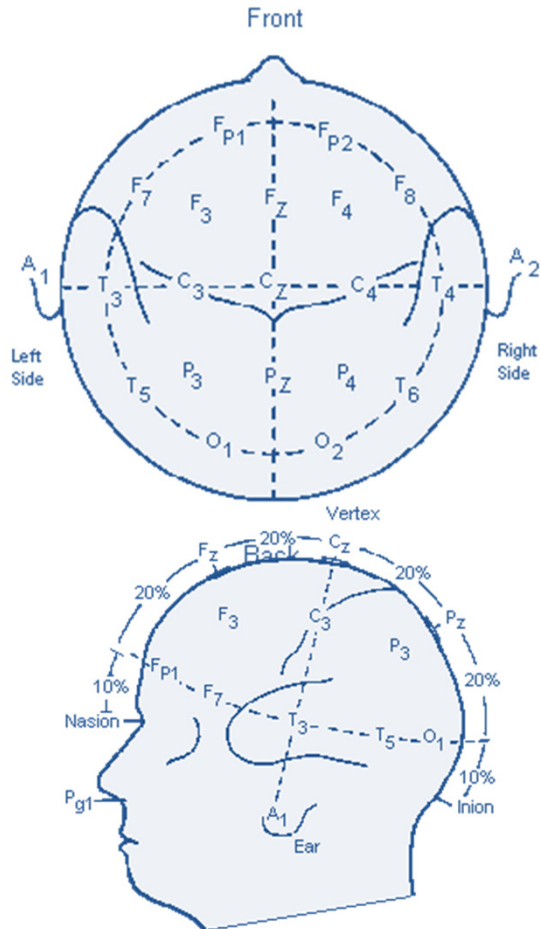
- Cortical maturation
- Cortical rytme
- Arousal level

# Cortical maturation and EEG



Brain activity: **Delta** (0,1-4 Hz) **Theta** (4-7 Hz) **Alpha** (8-11 Hz) **Beta**(12-30 Hz) **Gamma** (over 30 Hz)

# EEG - ADHD



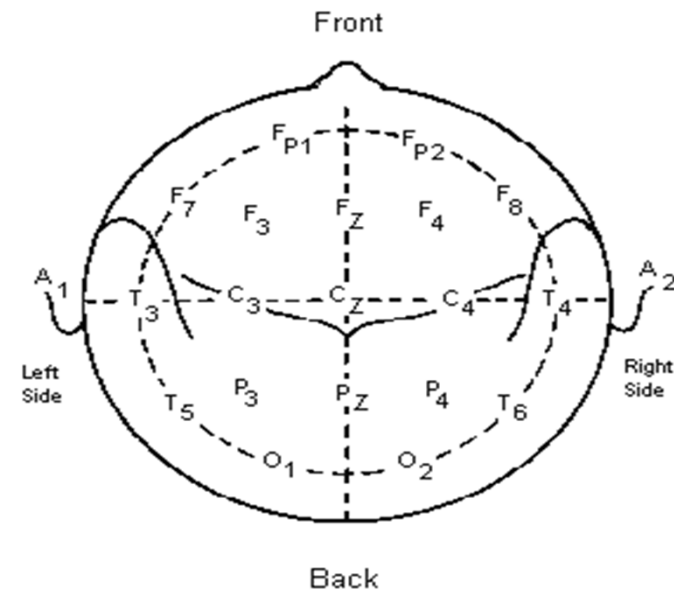
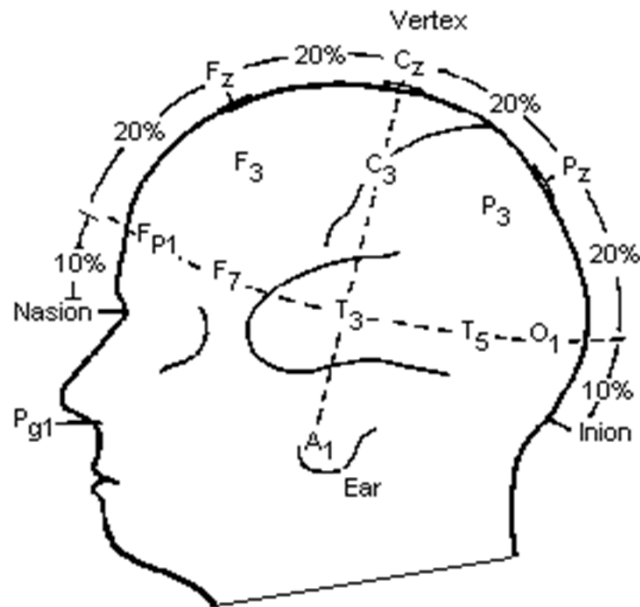
Increased levels of Theta and / or reduced levels of Beta or Alpha brain activity in persons with ADHD (Snyder, 2006); elevated Theta/beta ratio in resting EEG (Barry 2003); reduced CNV (Banaschewski, 2007)

Brain activity: **Delta** (0,1-4 Hz) **Theta** (4-7 Hz) **Alpha** (8-11 Hz) **Beta**(12-30 Hz) **Gamma** (over 30 Hz)



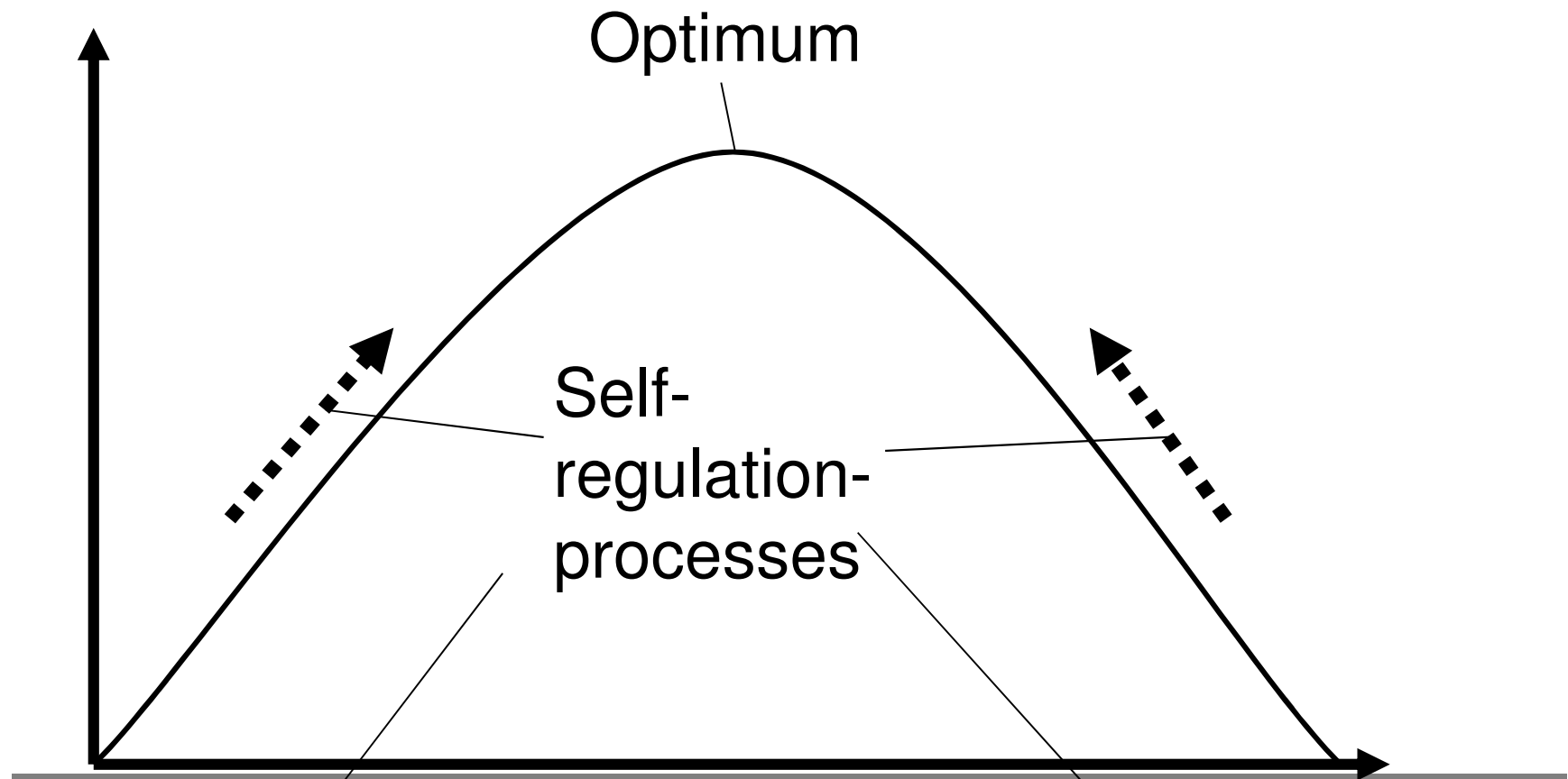
# The international 10-20-System of electrode/sensor positions

(Neuroscience for Kids, Erich H. Chudler)

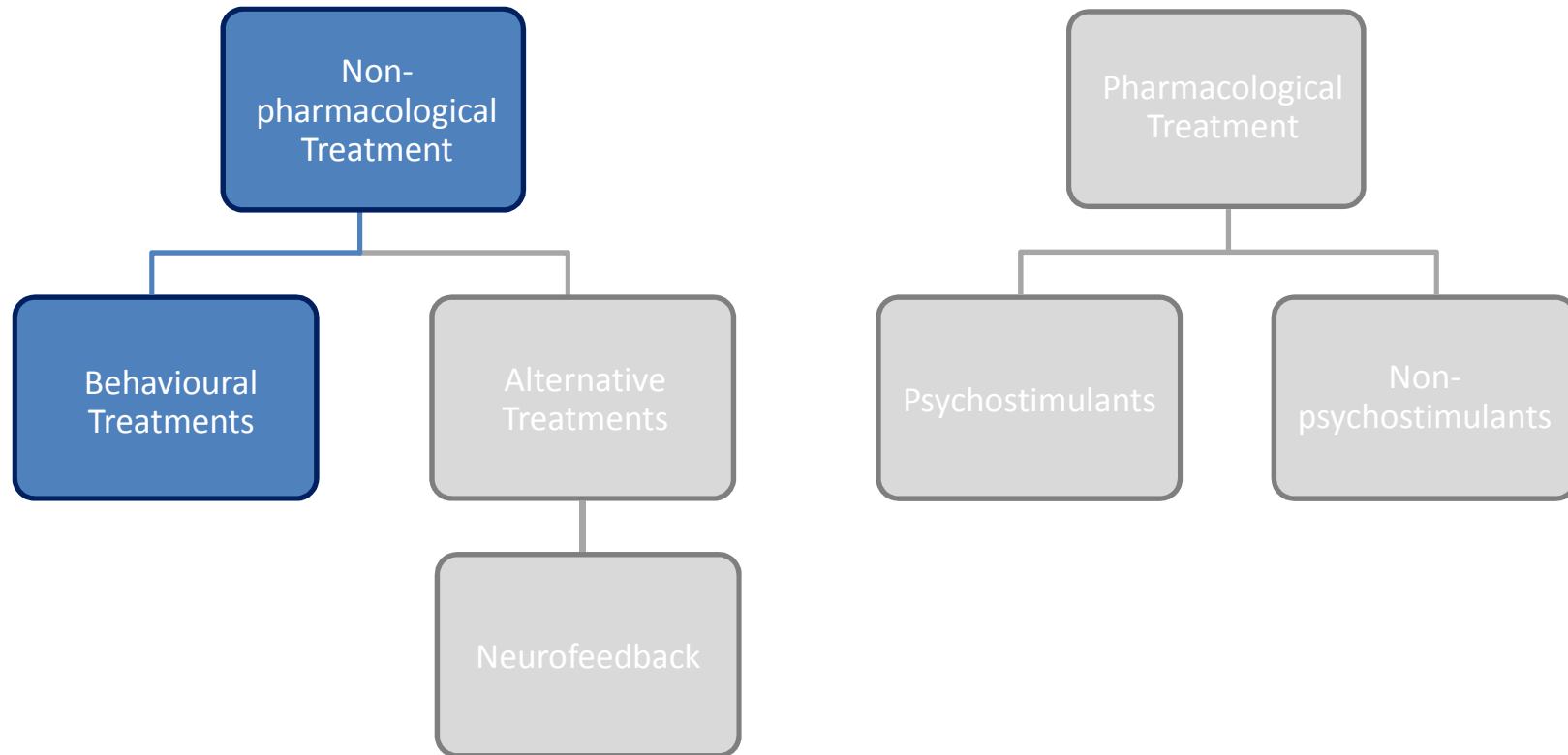


# Self-Regulation – Arousal Curve

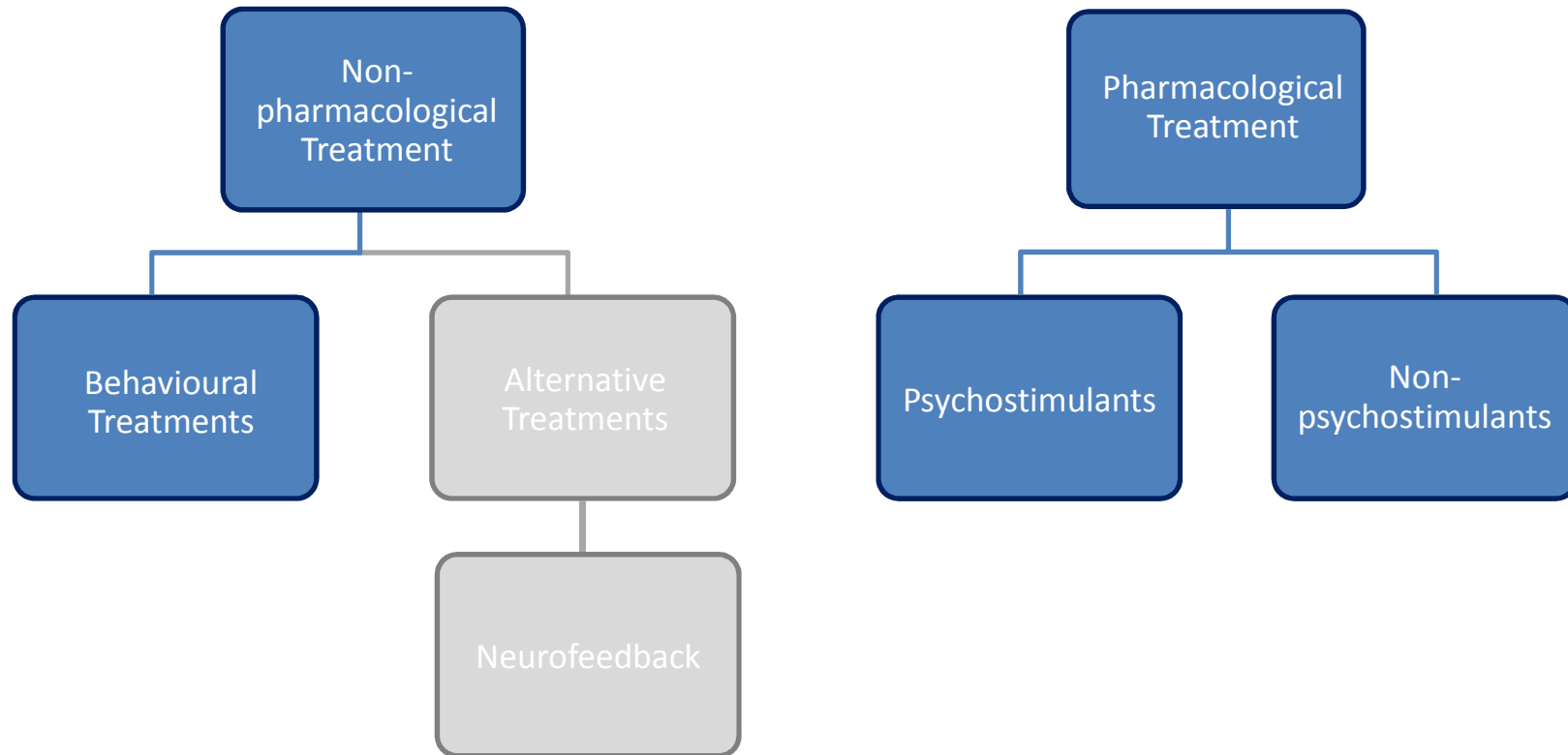
Performance



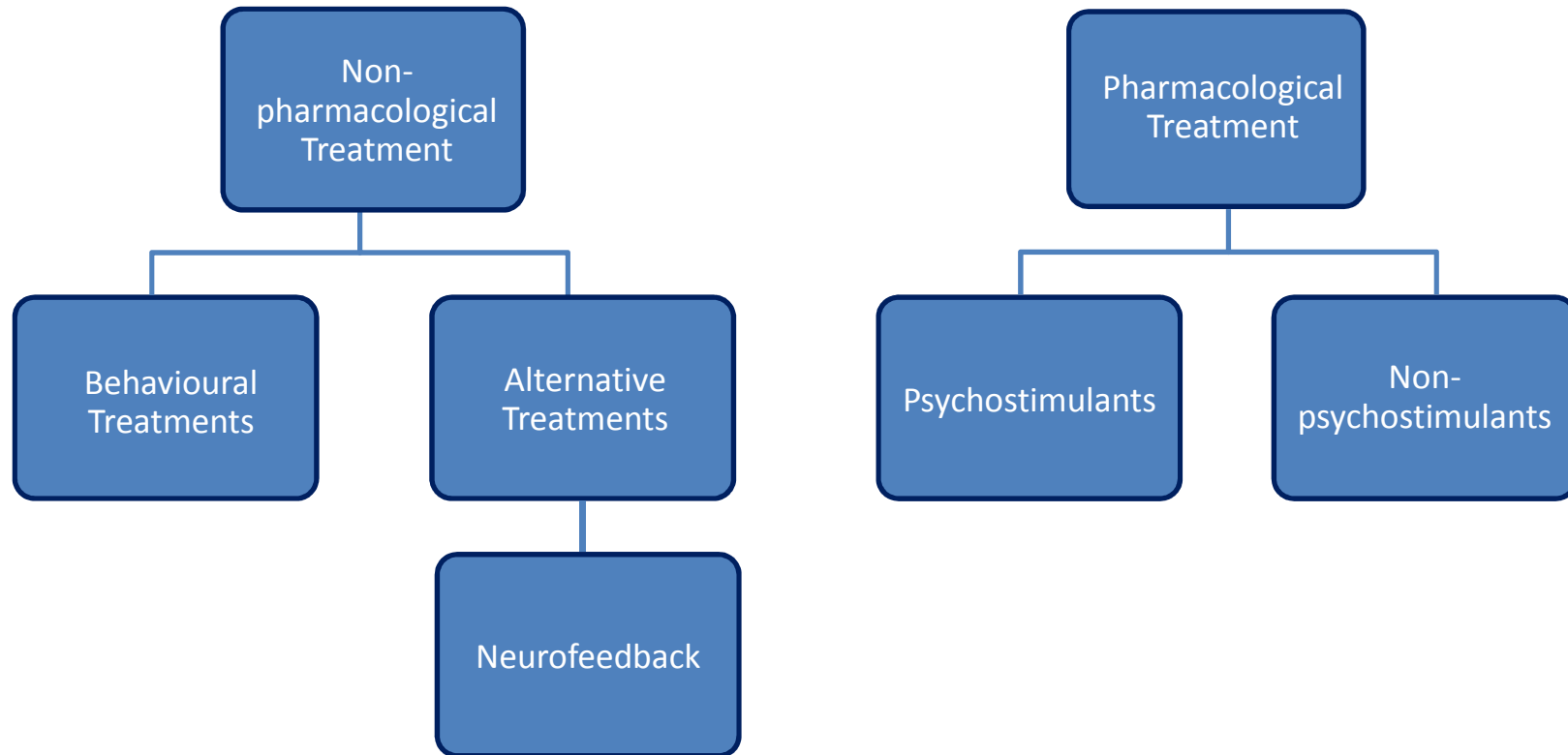
# ADHD and Treatment



# ADHD and Treatment



# ADHD and Treatment - Alternatives



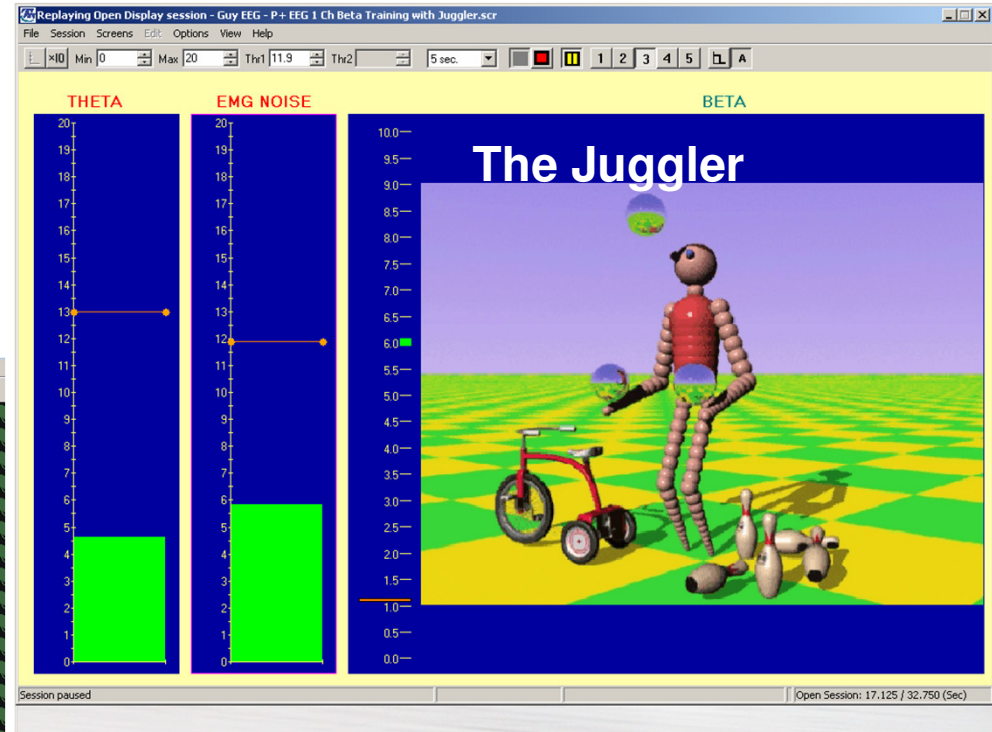
# Neurofeedback

- Training of self-regulation of brain activity
- Application: neurophysiological dysfunction and enhancement of self-regulation ability
- Feedback: visual, auditory, tactile



Heinrich, H., H. Gevensleben, and U. Strehl, *Annotation: neurofeedback - train your brain to train behaviour*. J Child Psychol Psychiatry, 2007.

# ADHD and NF games



# Children and Adolescents with ADHD

- UNIQUE STUDY DESIGN
- CLINICAL STUDY
- LARGE SAMPLE SIZE
- RANDOMIZATION
- CONTROL GROUP
- THREE ARMED GROUPS
- LONG-TERM STUDY



# Aims of the Study

## Part I

### Characteristics of ADHD

- Describe characteristics of Norwegian children and adolescents referred for ADHD symptoms.
- Explore primary healthcare ability to identify ADHD symptoms.
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## Part II

### ADHD and Treatment

- Evaluate the effect of NF treatment on ADHD core symptoms using self-report, parent`s, and teacher`s reports.
- Compare NF treatment for ADHD children and adolescents with standard medical treatment and combined treatment.

# Aims of the Study

## Part I

### Characteristics of ADHD

- Describe characteristics of Norwegian children and adolescents referred for ADHD symptoms.
- Explore primary health care's ability to identify ADHD symptoms.
- Explore primary health care's knowledge with ADHD regarding clinical characteristics.

## Part II

### ADHD and Treatment

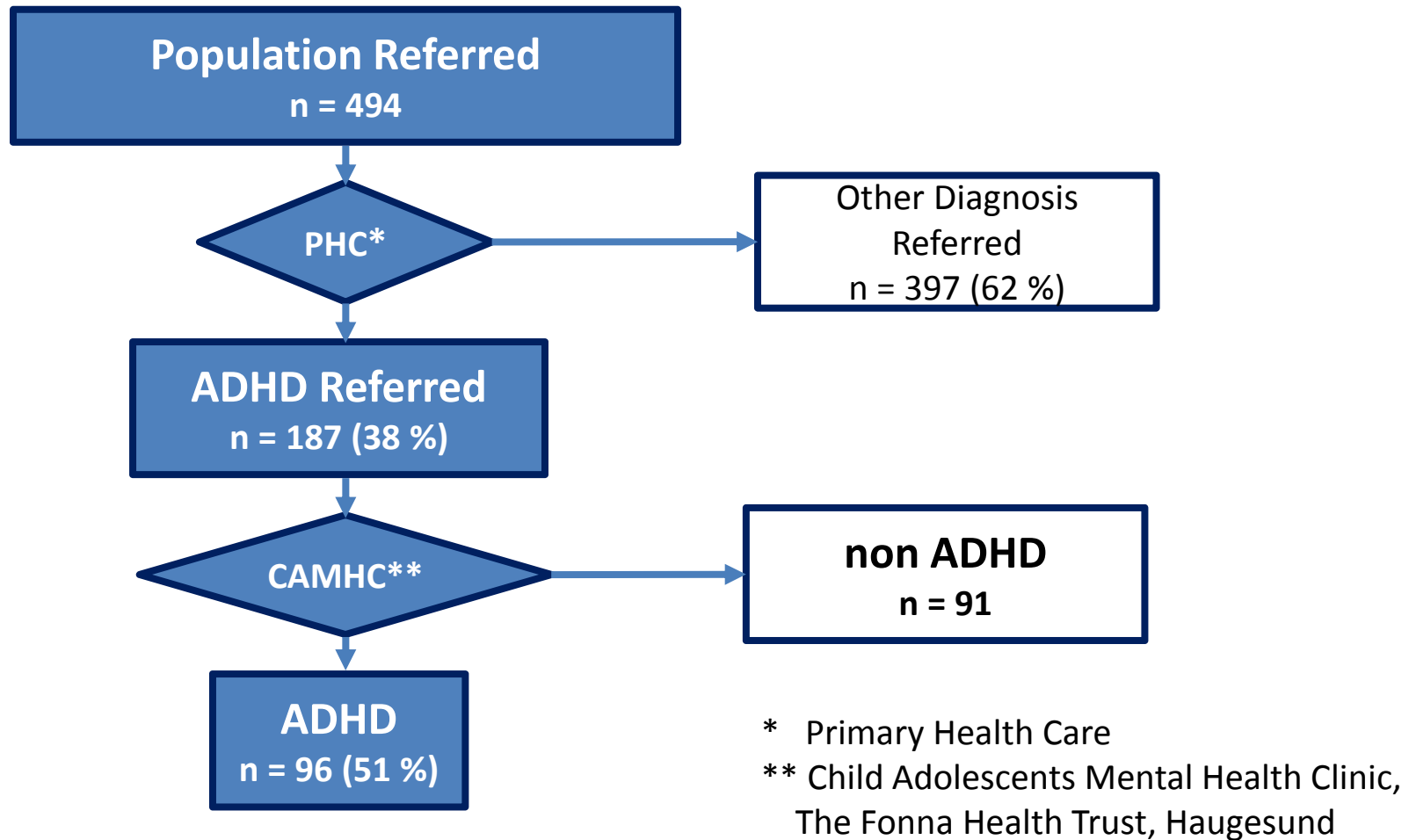
- Evaluate the effect of NF treatment on ADHD core symptoms using self-report, parent`s, and teacher`s reports.
- Compare NF treatment for ADHD children and adolescents with standard medical treatment and multimodal treatment.

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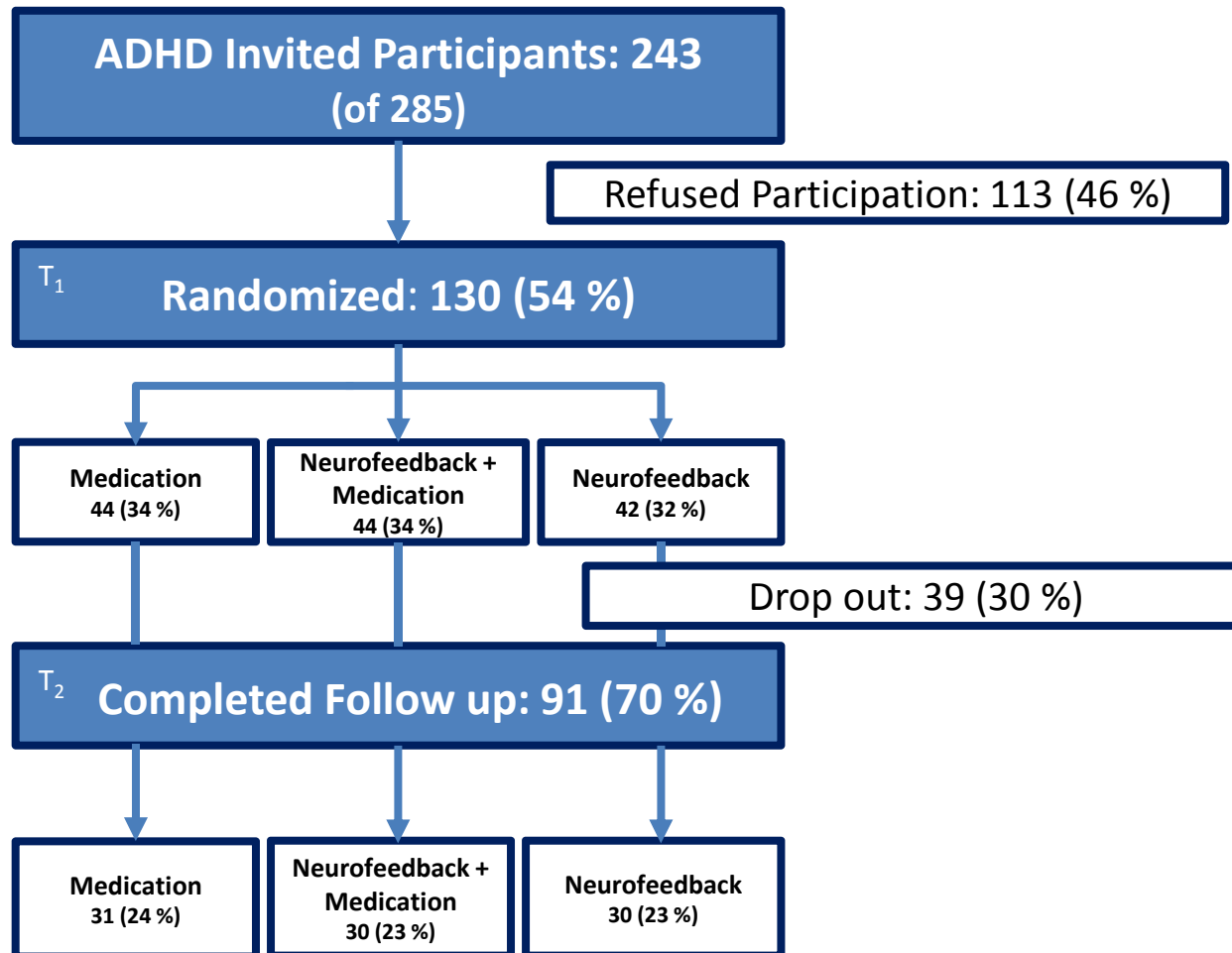
## Part III qEEG in ADHD

- Define qEEG changes -Biomarkers
- Define qEEG changes \_ Treatment predictors
- Exploare correlation between behavioral and qEEG parametars

# Participants Part I: Characteristics of ADHD



# Participants Part II/III: Treatment and qEEG



# Methods

## ADHD

### Part I

- ADHD multimodal clinical assessment
- Anamnesis
- Clinical examination (blood, EEG, EKG)
- Psychiatric observation
- ICD-10 interview
- Cognitive evaluation

## Treatment

### Part II+III

- Neurofeedback Treatment
- Pharmacological Treatment
- Parent report: Barkley Parent Scale
- Teacher report: Barkley Teacher Scale
- Self-report: SRQ
- qEEG

# ADHD Treatment in the study

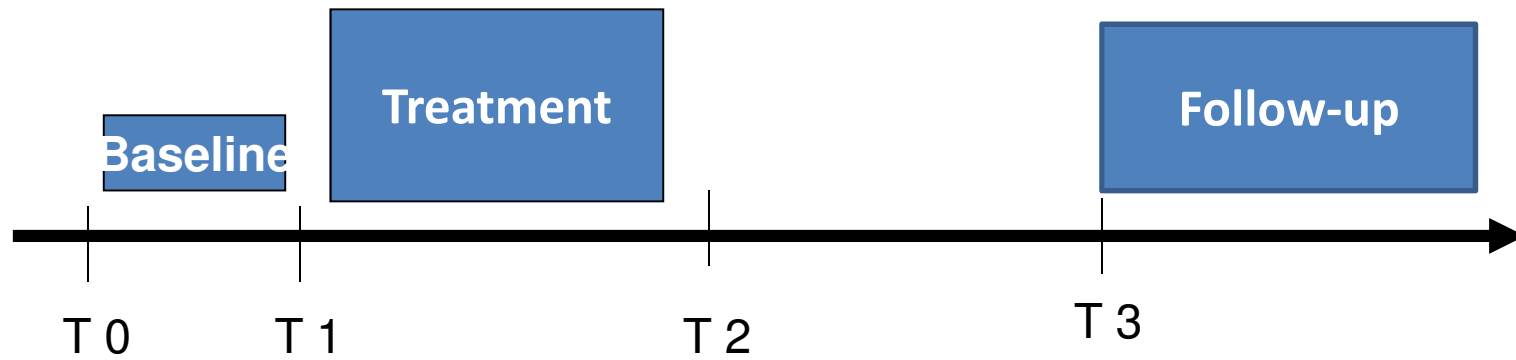
## Neurofeedback

- Lubar Theta/Beta – SMR protocol
- 30 sessions : 11-13 weeks

## Stimulant Medication

## Multimodal treatment

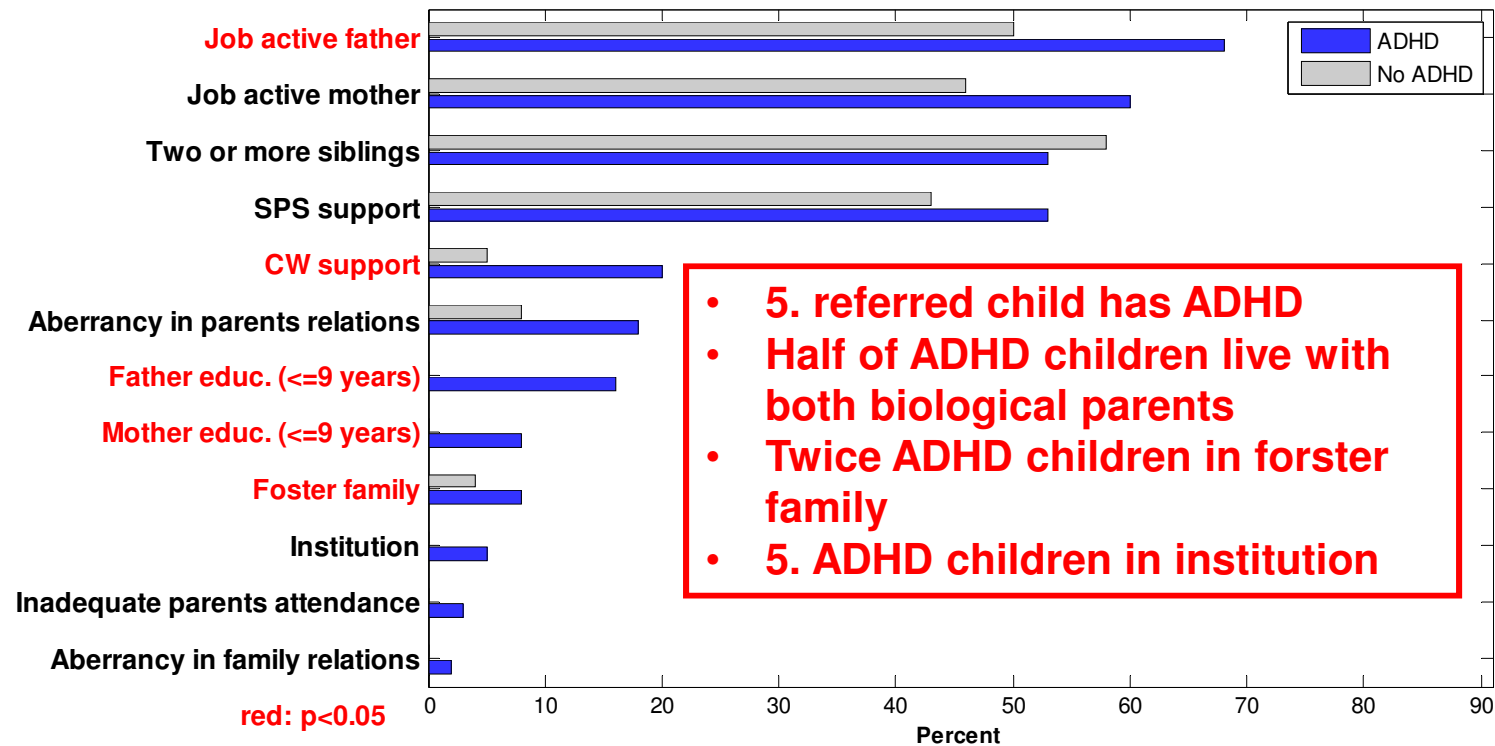
# Time perspective





## Results Part I:

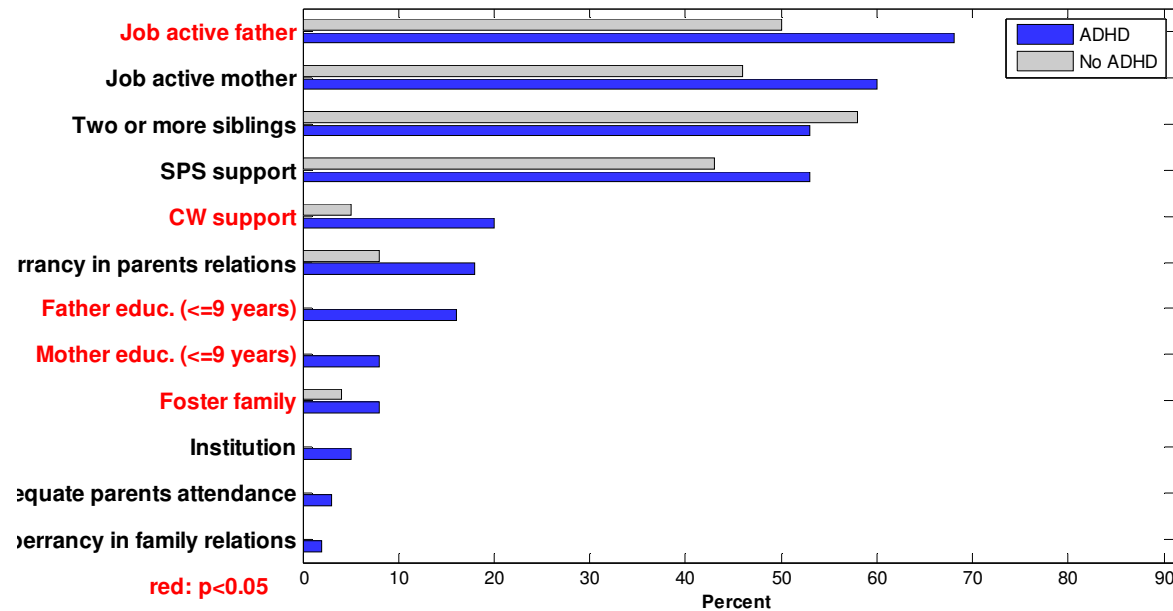
# Characteristics of **ADHD referred population** (N=187)



## Results Part I:

# Characteristics of **ADHD referred population** (N=187)

**Average referral age 10,5 år; 82% boys**



- 5. referred child has ADHD
- Half of ADHD children live with both biological parents
- Twice ADHD children in foster family
- 5. ADHD children in institution

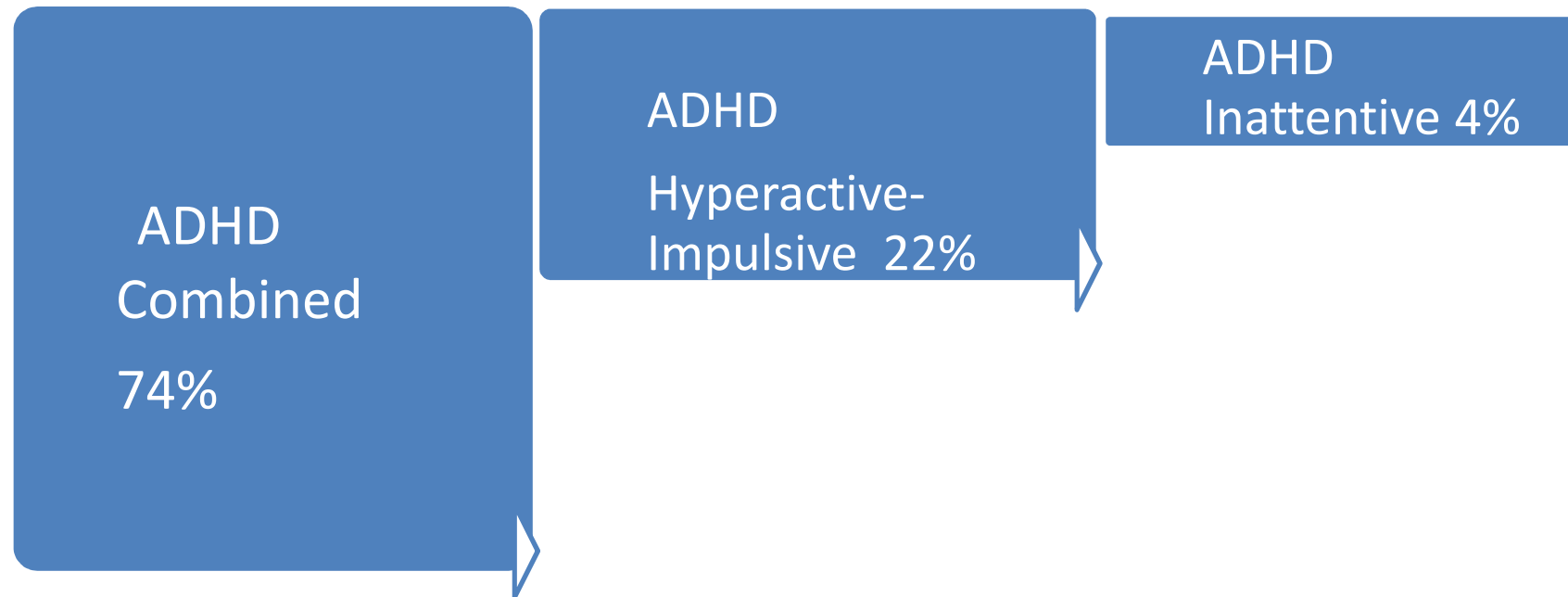
## Results Part I:

# Characteristics of **ADHD referred population** (N=187)

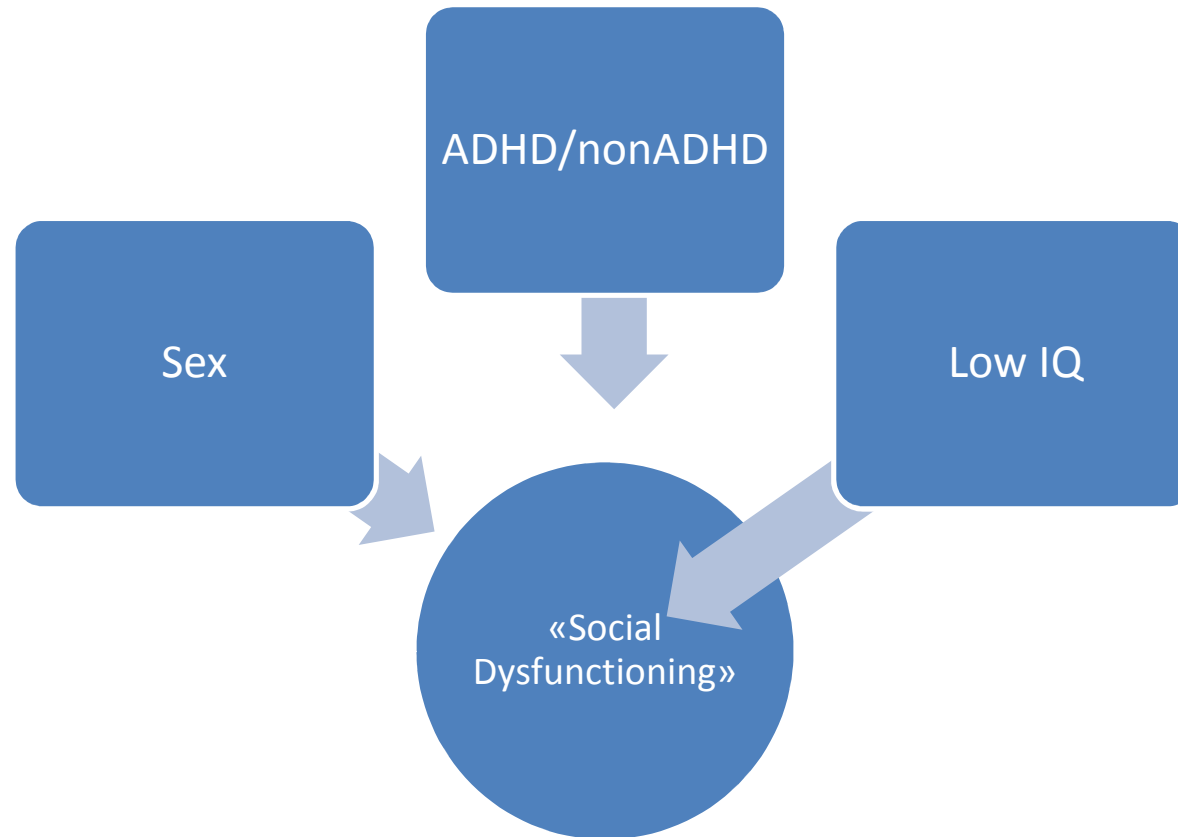
## Clinical examination:

- Increased risk of low birth weight
- increased TSH
- Somatic co-morbid conditions

# Characteristics of ADHD population



# Characteristics of ADHD population



# Primary Health Care

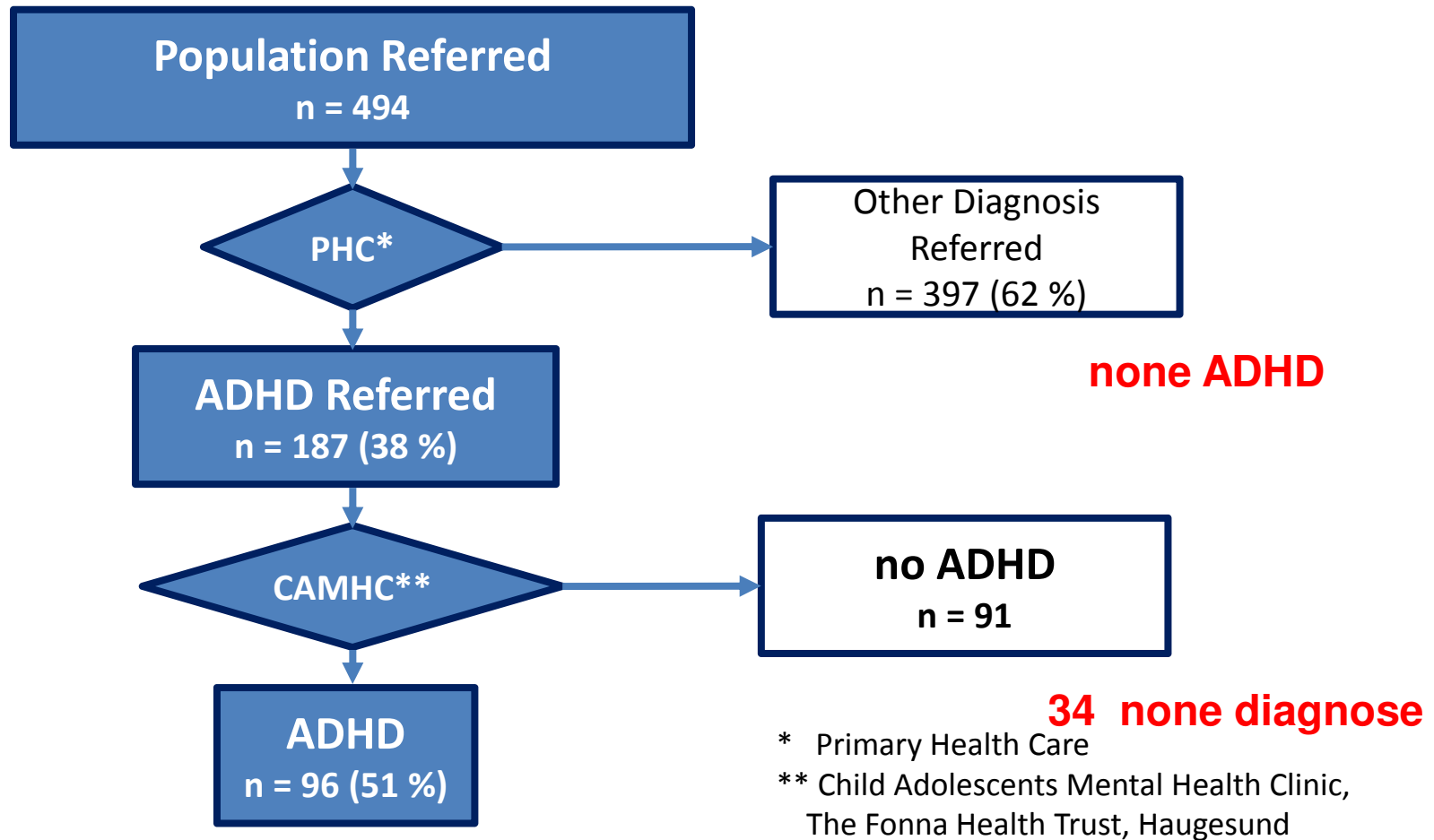
Primary health care services's ability to identify ADHD symptoms

1/3 of all referred children were referred for ADHD

1/2 of ADHD referred children were diagnosed with ADHD

1/5 of ADHD referred children were not diagnosed at all

# Participants Part I: Characteristics of ADHD



# Primary Health Care

- The sensitivity was 51% (96/187) regarding primary health care`s ability to recognize ADHD.
- The specificity was 100% (0/494)
- **Need for specific screening programs and diagnostic guidelines for primary health care**



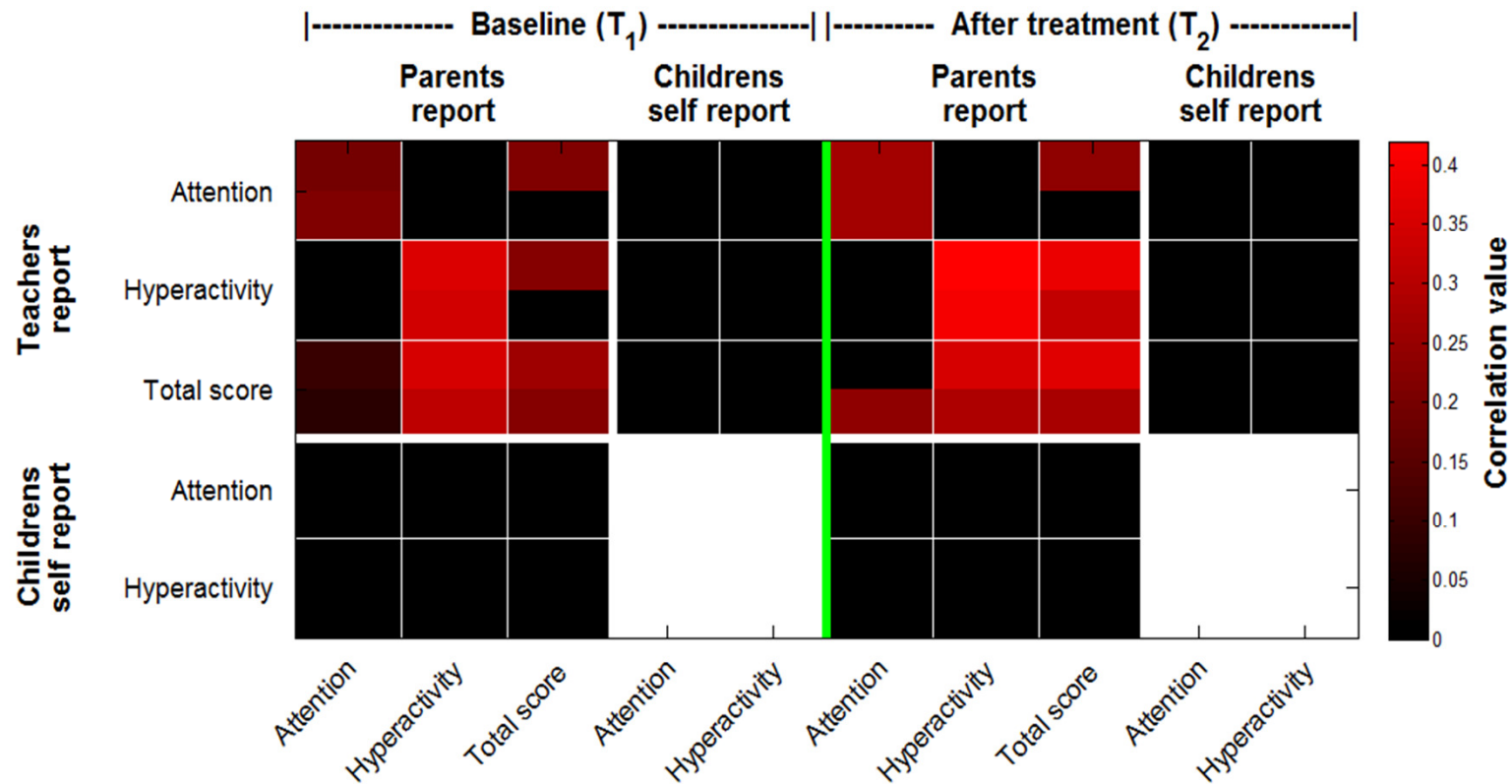
## Results Part II:

# Treatment Response based on reports one week later

	Pre-post Change (within the groups)			Treatment Effect (between the groups)		
	Attention	Hyperactivity	Total score	Attention	Hyperactivity	Total score
<b>Parents</b>	$p < 0,001$	$p < 0,001$	$p < 0,001$	$p = 0,098$	$p = 0,101$	$p = 0,173$
<b>Teachers</b>	$p < 0,001$	$p = 0,209$	$p < 0,001$	$p < 0,001$	$p = 0,425$	$p = 0,656$
<b>Children/ Adolescents</b>	$p < 0,001$	$p < 0,001$		$p = 0,322$	$p = 0,009$	

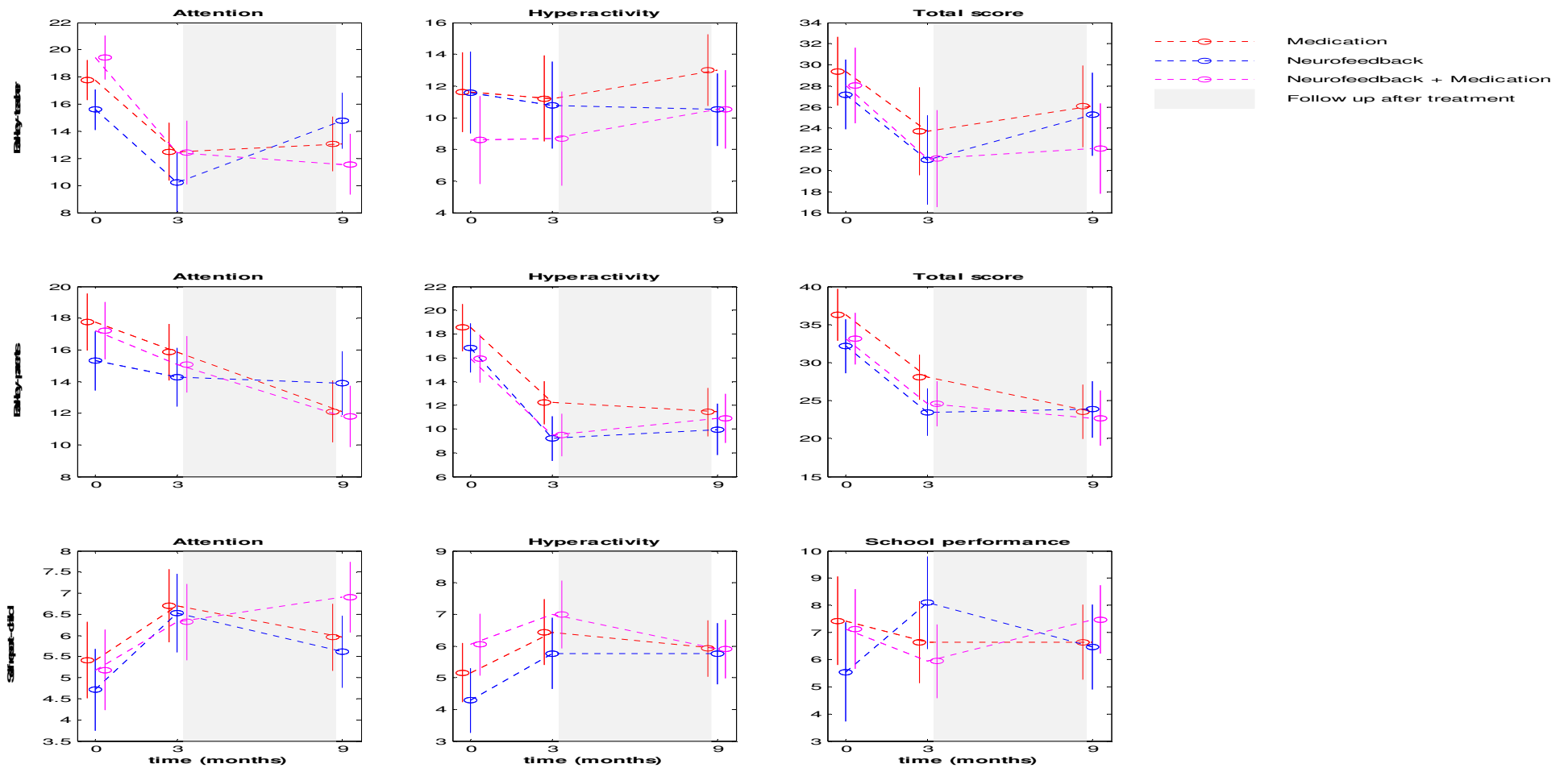
\* Adjusted models did not show any effect (power)

# Results Part II: Correlation Children, Parent`s and Teacher`s reports



# Results Part II: Treatment Response based on reports **LONG TERM**

- Effectiveness Patterns towards Treatment



Results Part II:  
**Treatment Response based on reports**  
**LONG TERM**

New evidence for the long-term efficacy of  
**multimodal treatment:**

- stimulant medication
- NF

# Conclusion: Part I

Referral	Environment of ADHD children
<ul style="list-style-type: none"><li>• <b>High ADHD referral in late school age</b></li><li>• <b>Low diagnostic identification</b></li></ul> <p><b>=&gt; “ADHD-guidelines” for Primary Health Care needed</b></p>	<ul style="list-style-type: none"><li>• Single parent / foster families</li><li>• Low parents education</li><li>• Child welfare</li><li>• Social dysfunction</li><li>• Low IQ</li><li>• High co-morbidity</li></ul>

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# Conclusion: Part II

Pre-post changes	Treatment effect
<ul style="list-style-type: none"><li>• <b>Significant improvement of ADHD core symptoms regardless treatment type</b></li><li>• <b>Different focus from raters</b></li></ul>	<ul style="list-style-type: none"><li>• <b>Neurofeedback is promising reported shortly after treatment</b></li><li>• <b>Combined treatment makes no superior efficacy</b></li></ul>

# Conclusion: Part II

Pre-post changes	Treatment effect
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## Part III Qeeg

### Biomarkers

- Frequencies
- Ratio

### Predictors

- The brain's electrical profile under different tasks

# Future perspectives

- Follow up over time
- qEEG analyses

# Papers

1. Duric N.S., Elgen I.

**Characteristics of Norwegian children suffering from ADHD symptoms: ADHD and primary health care.** Psychiatry Research. 2011, 188 (2011) 402-405. (Number of citations: 4)

2. Duric N.S., Elgen I.

**Norwegian Children and Adolescents with ADHD – A Retrospective Clinical Study: Subtypes and Comorbid Conditions and Aspects of Cognitive Performance and Social Skills.** Adolescent Psychiatry, 2011, Vol. 1, No. 4. (Number of citations: 3)

3. Duric N.S., Assmuss J., Gundersen D., Elgen I.

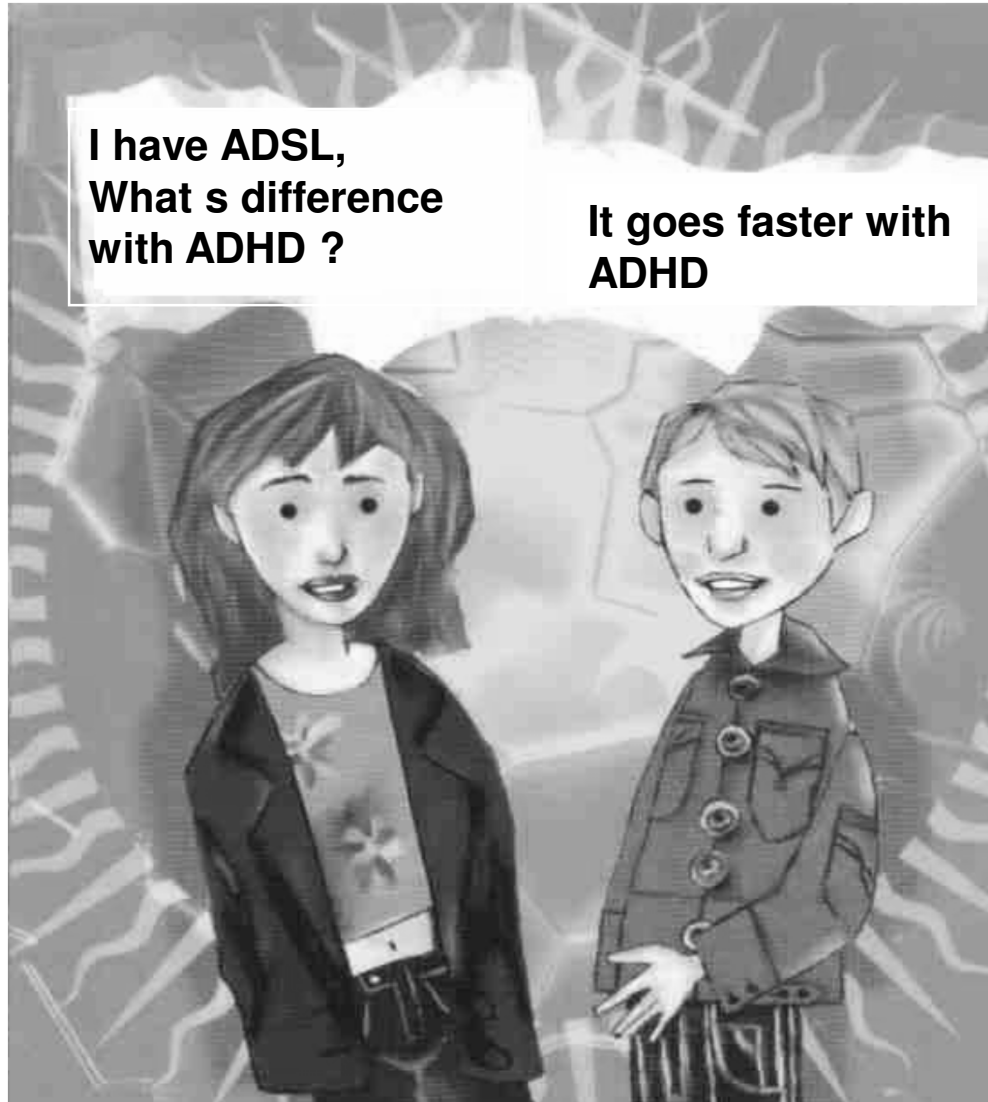
**Neurofeedback for the treatment of children and adolescents with ADHD: a randomized and controlled clinical trial using parental reports.** BMC Psychiatry, 2012, Vol.12, No. 1; 107. (Number of citations: 12)

4. Duric N.S., Assmuss J., Elgen I.

**NF treatment of children and adolescents with ADHD: Self-reported evaluation.** Child and Adolescent Psychiatry and Mental Health, **December 2013.**

**I have ADSL,  
What s difference  
with ADHD ?**

**It goes faster with  
ADHD**



# Thank you