Psychological treatment for ADHD
Can they be made to work?

Edmund Sonuga-Barke

DO NON-PHARMA ADHD TREATMENTS WORK? DEPENDS WHAT YOU MEAN! DEPENDS WHO YOU ASK!

- Do they control core ADHD symptoms?
- Do parents think things have improved?
- Do they reduce other common comorbidities
- Do they improve everyday functioning?
- Do they change parent's attitudes/behaviours to child?
- Do they promote parental wellbeing?
- Do they strengthen family functioning?
- Do they increase QoL in the long run?

RUNNING ORDER

- Why is a stringent systematic assessment of non-pharma interventions needed?
- EAGG methodology and strategy.
- Moving form targeting symptoms to underlying processes.
  - Behavioural Interventions (Daley et al., 2014).
  - Cognitive Training (Cortese et al., 2015).
  - Neurofeedback (Cortese et al., 2016).
- Early intervention – a way forward?

THE EUROPEAN ADHD GUIDELINES GROUP

KNOWLEDGABLE AND PASSIONATE ABOUT ADHD TREATMENT

Sergeant (Netherlands: Chair); Banaschewski (Germany); Brandeis (Switzerland/Germany); Buitelaar (Netherlands); Coghill (UK); Cortese (US/Italy); Danckaerts (Belgium); Daley (UK); Dittman (Germany); Doepfner (Germany); Ferrin (UK/Spain); Fallisard (France); Hollis (UK); Konofal (France); Lecendreux (France); Rothenberger (Germany); Santosh (UK); Sayal (UK); Sonuga-Barke (UK/Belgium); Simonoff (UK); Stevenson (UK); Steinhausen (Switzerland/Denmark); Stringaris (UK); Thompson (UK); Van der Oord (Belgium); Wong (Hong Kong/UK); Zuddas (Italy); Santosh (UK); Holtman (Germany); Taylor (UK).

NEED FOR THE RECENT EAGG REVIEWS

- Medication - front-line treatment - effective but limited
  - normalization – rare
  - key functional outcomes untouched
  - long term effects - uncertain
  - side effects – frequent
  - resistance from parents and clinicians
  - societal concern about the increasing prescribing rates.
- Effective non-pharmacological treatments are essential.
- EAGG produced treatment guidelines previously.
- Ten years ago decided to create non-pharma guidelines.
- We had loads of expertise - thought we knew the literature – easy then!

A STRINGENT SYSTEMATIC REVIEW OF THE EVIDENCE WAS NEEDED

- What we found was that NPTs are recommended on the basis of systematic reviews and meta-analyses.
- Given this we initially considered a light touch – review of reviews - to generate our evidence.
- However – when we looked closely we found the existing reviews unsatisfactory in a number of ways.

On balance we did not feel the reviews were of sufficient quality to recommend NPT for ADHD.

Unfortunately some heavy lifting was needed.

EAGG METHODOLOGY

INCLUSION CRITERIA

- Randomised Controlled Trials with a suitable control arm.
- Peer reviewed
- ADHD diagnosis & outcome.
- 3 to 18 years

OUTCOMES

- The primary outcome was ADHD symptoms.

- The issue of blinding addressed by comparing two outcomes.

  - *MPROX – The ADHD assessment most proximal to the intervention setting – least likely to be blinded.*

  - *P-BLIND – Only ADHD outcomes where the rater was likely to be unaware of treatment allocation – most likely to be blinded.*

NON-PHARMACOLOGICAL TREATMENTS REVIEWED

PSYCHOLOGICAL INTERVENTIONS

a)Behavioural interventions

b)Neurofeedback

c) Cognitive training

DIETARY INTERVENTIONS

d) Restrictive elimination diets.

e) Artificial food colour exclusion.

f) Free fatty acid supplements.

g) Other supplements

MOVING FROM TARGETING ADHD SYMPTOMS TO UNDERLYING PROCESSES

BEHAVIOURAL INTERVENTIONS

- Based on reinforcement and social learning models.
- Delivered 1-2-1 or groups/at home or clinic - vary in duration/intensity.
- Trains parents and/or teachers in ways to modify their child's behaviour by manipulating behavioural antecedence and consequences and modeling appropriate behaviours.
- Antecedents - Restructures child's social and physical environment to ensure clear rules and expectations - communicated clearly and improves parent-child relationship quality.
- Consequences – Positively reinforces appropriate behaviours and negatively reinforce alternatives to inappropriate behaviours.
- Can be implemented with social/organisational/academic skills training.

BUT ARE POSITIVE EFFECTS OF BPT ON CORE ADHD SYMPTOMS EXPECTABLE?

BPT DEVELOPED FOR CONDUCT PROBLEMS ASSUMED TO EMERGE FROM COERCIVE PARENT-CHILD INTERACTIONS WHICH CAN BE REMEDIED BY PARENTS' ALTERED RESPONSE TO CHILDRENS' BEHAVIOUR.

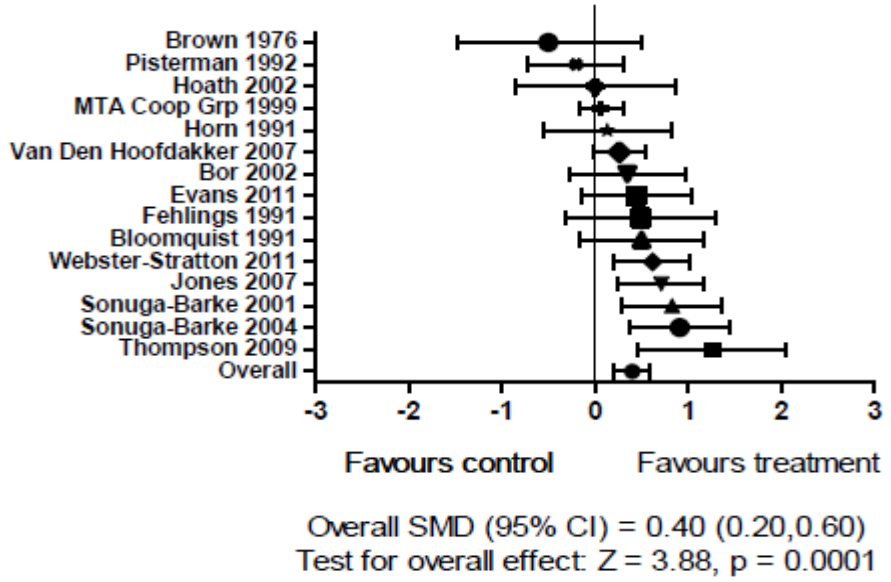
IS THIS A REASONABLE EXPECTATION FOR ADHD?

ARE THERE OTHER MORE EXPECTABLE POSITIVE BENEFITS OF BPT?

PARENTING BEHAVIOUR?

CHILD CONDUCT PROBLEMS?

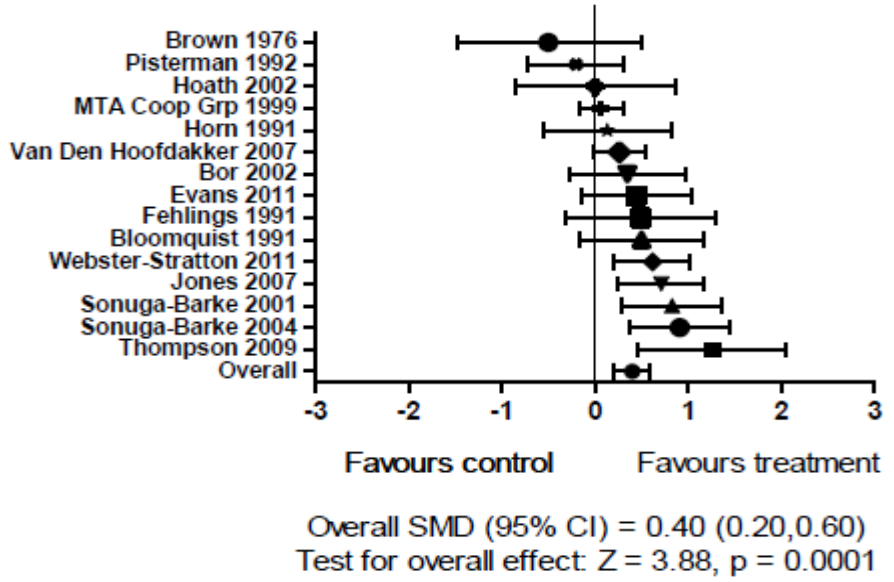
BEHAVIOURAL INTERVENTIONS



M-PROX

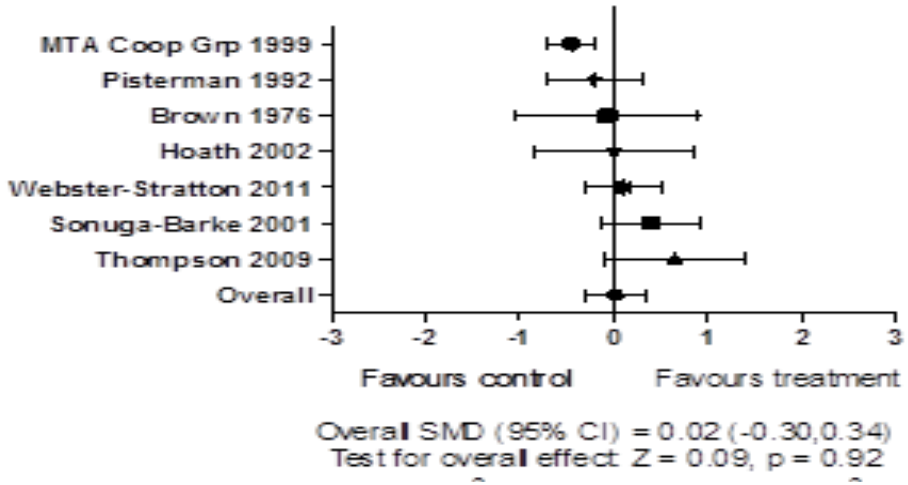
ES = 0.40*

BEHAVIOURAL INTERVENTIONS



M-PROX

ES = 0.40*



P-BLIND

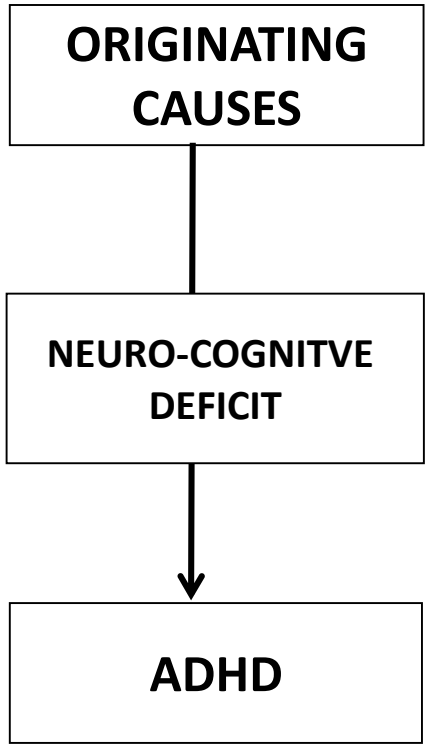
ES = 0.02

MOVING FROM TARGETING ADHD SYMPTOMS TO UNDERLYING PROCESSES

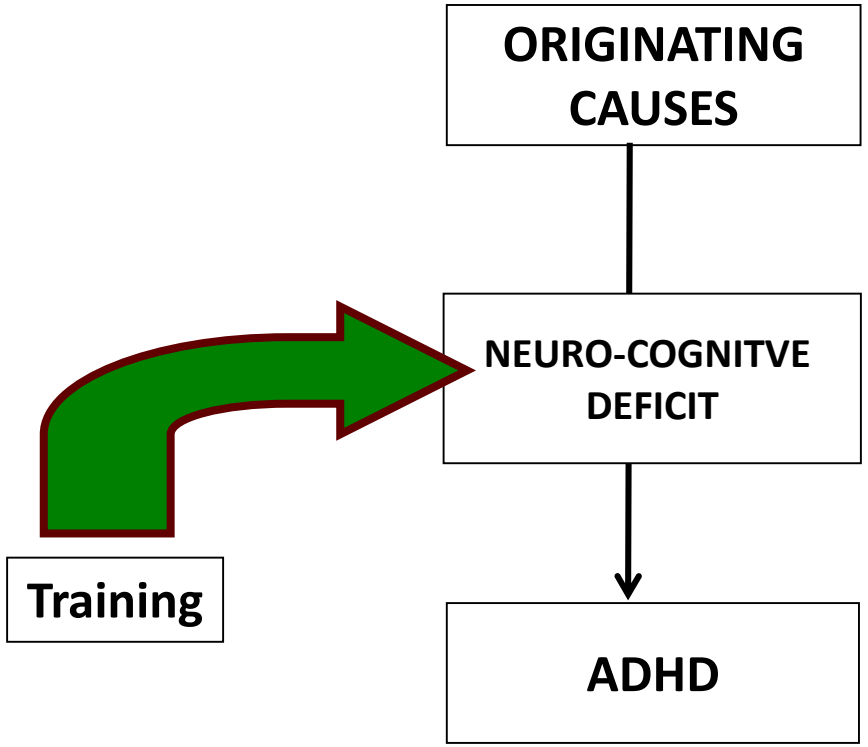
IF WE WANT TO TARGET ADHD SYMPTOMS DO WE NEED A RADICALLY DIFFERENT APPROACH TO TREATMENT?

A TRANSLATIONAL MODEL HOLDS OUT THE PROMISE THAT PSYCHO-THERAPEUTIC INNOVATION CAN BE BUILT ON SCIENTIFIC DISCOVERIES ABOUT ADHD PATHOGENESIS.

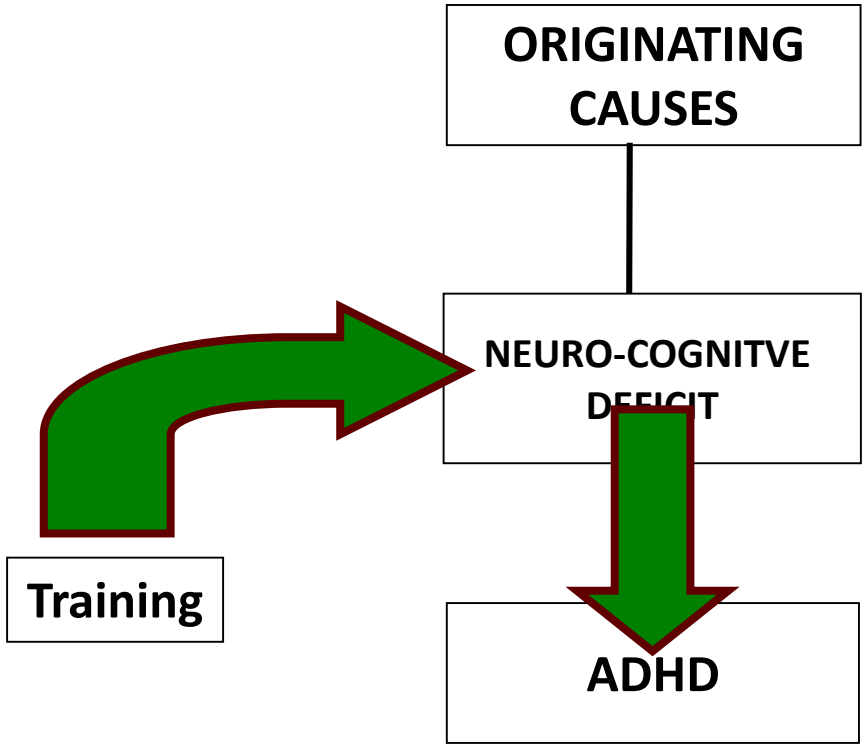
COGNITIVE MEDIATORS OF CAUSAL PATHWAYS BECOME TARGETS FOR REMEDIATION



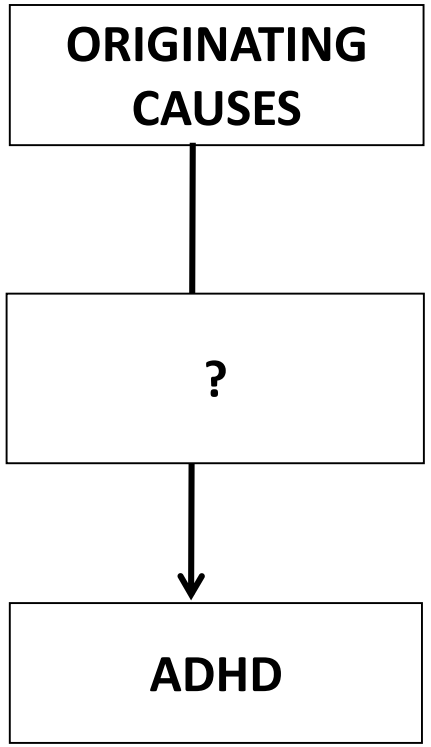
COGNITIVE MEDIATORS OF CAUSAL PATHWAYS BECOME TARGETS FOR REMEDIATION



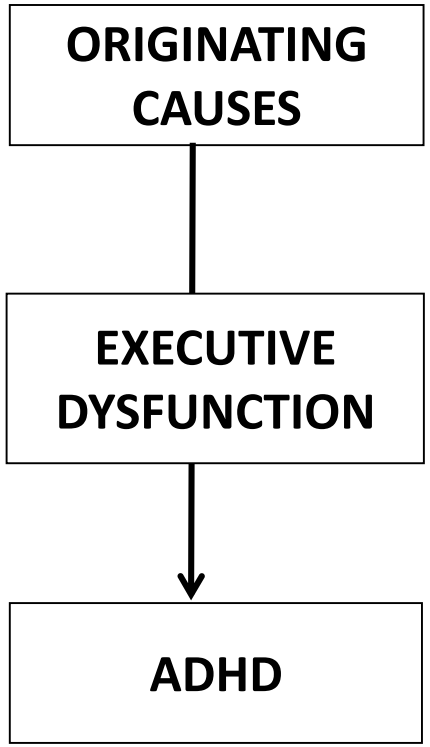
COGNITIVE MEDIATORS OF CAUSAL PATHWAYS BECOME TARGETS FOR REMEDIATION



FOUNDATIONAL QUESTION
WHAT COGNITIVE DEFICITS MEDIATE ADHD CAUSAL PATHWAYS?



THE BARKLEY MODEL (REVISITED)



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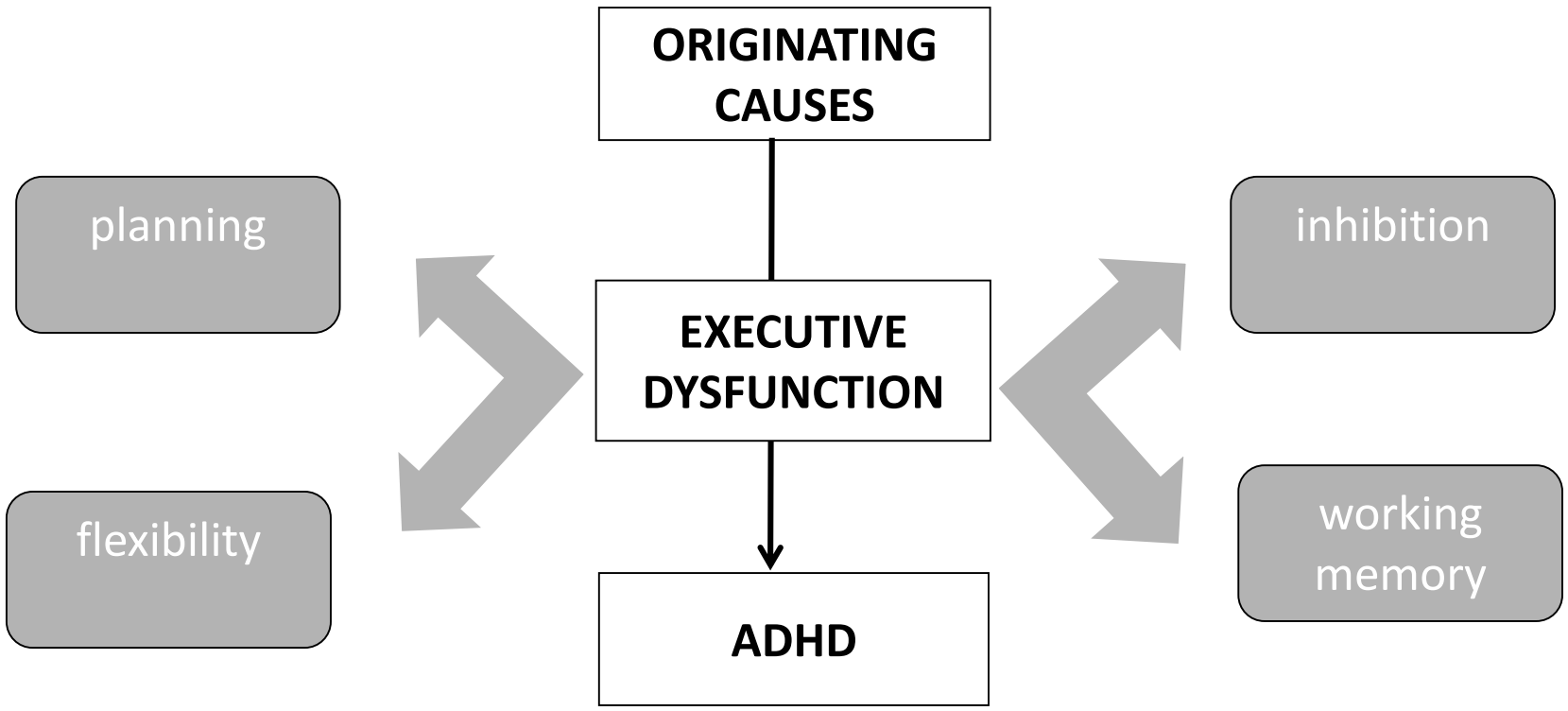


FROM STRATEGY TO TACTICS
RESPONDING TO THE NEUROPSYCHOLOGICAL IMPAIRMENT

“SCALPEL”

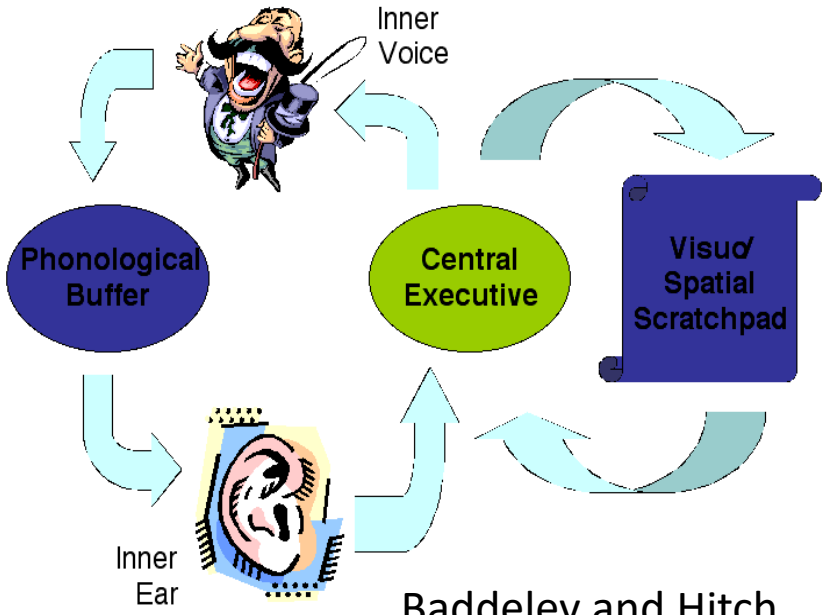
OR

“SHOTGUN”

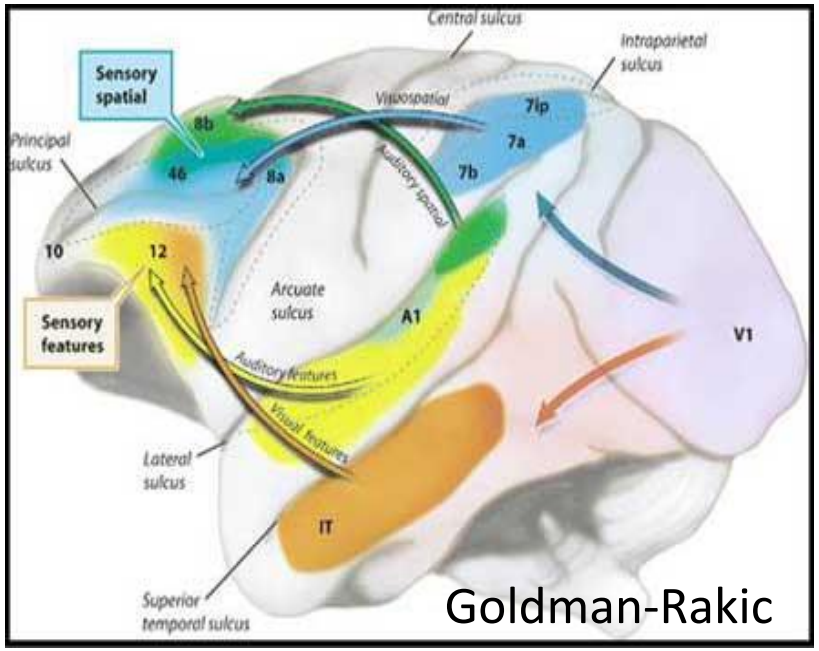
THE WORKING MEMORY TRAINING
“SCALPEL”

WORKING MEMORY TRAINING FOR ADHD – A PRECISION APPROACH TO COGNITIVE TRAINING

"A mental workbench" (Klingberg, 2009)
"Dynamic brain process that helps us create and maintaininternal representations" (Tannock, 2010)



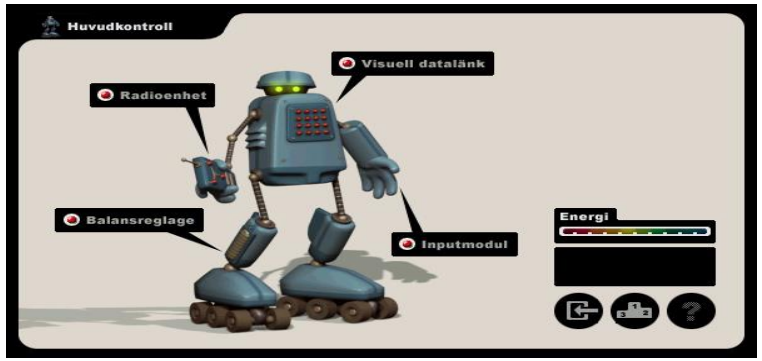
Baddeley and Hitch

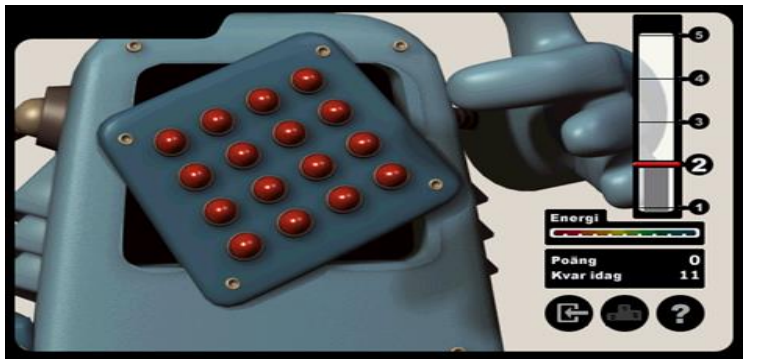


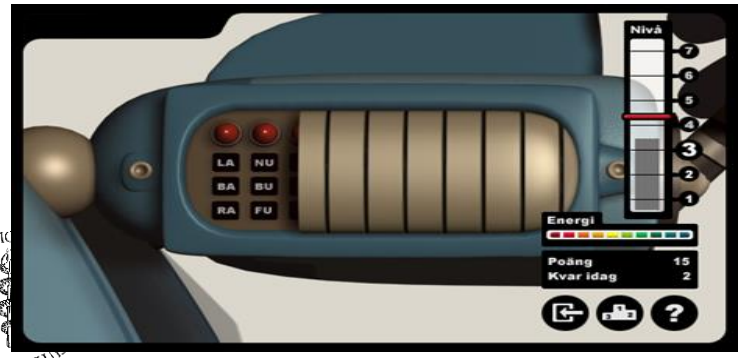
Goldman-Rakic

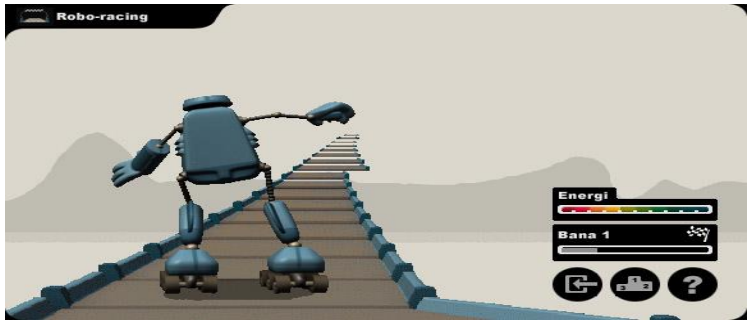
ROBO MEMORY BE COGMED IS THE MOST WIDELY USED AND THOROUGHLY EVALUATED COGNITIVE TRAINING APPROACH

THE PIONEERING WORK BY TORKEL KLINGBERG AND HIS TEAM AT THE KAROLINSKA

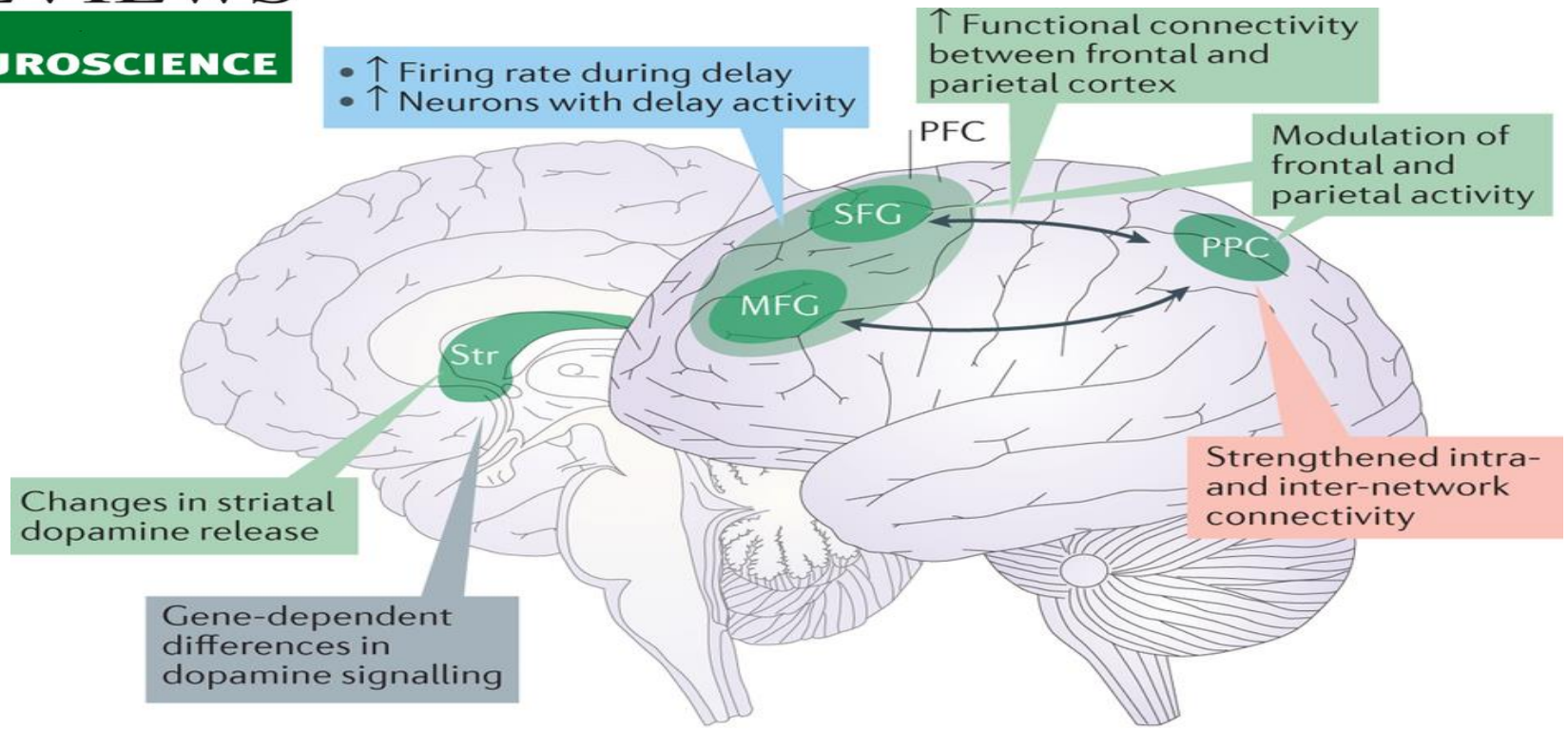








IT CHANGES THE BRAIN



Christos Constantinidis & Torkel Klingberg
Nature Reviews Neuroscience 17, 438–449 (2016)

THE MULTI-SYSTEMS TRAINING
“SHOTGUN”

THE WORKS OF BRAIN: A GAMIFIED MULTI- PROCESS TRAINING

Research Brief

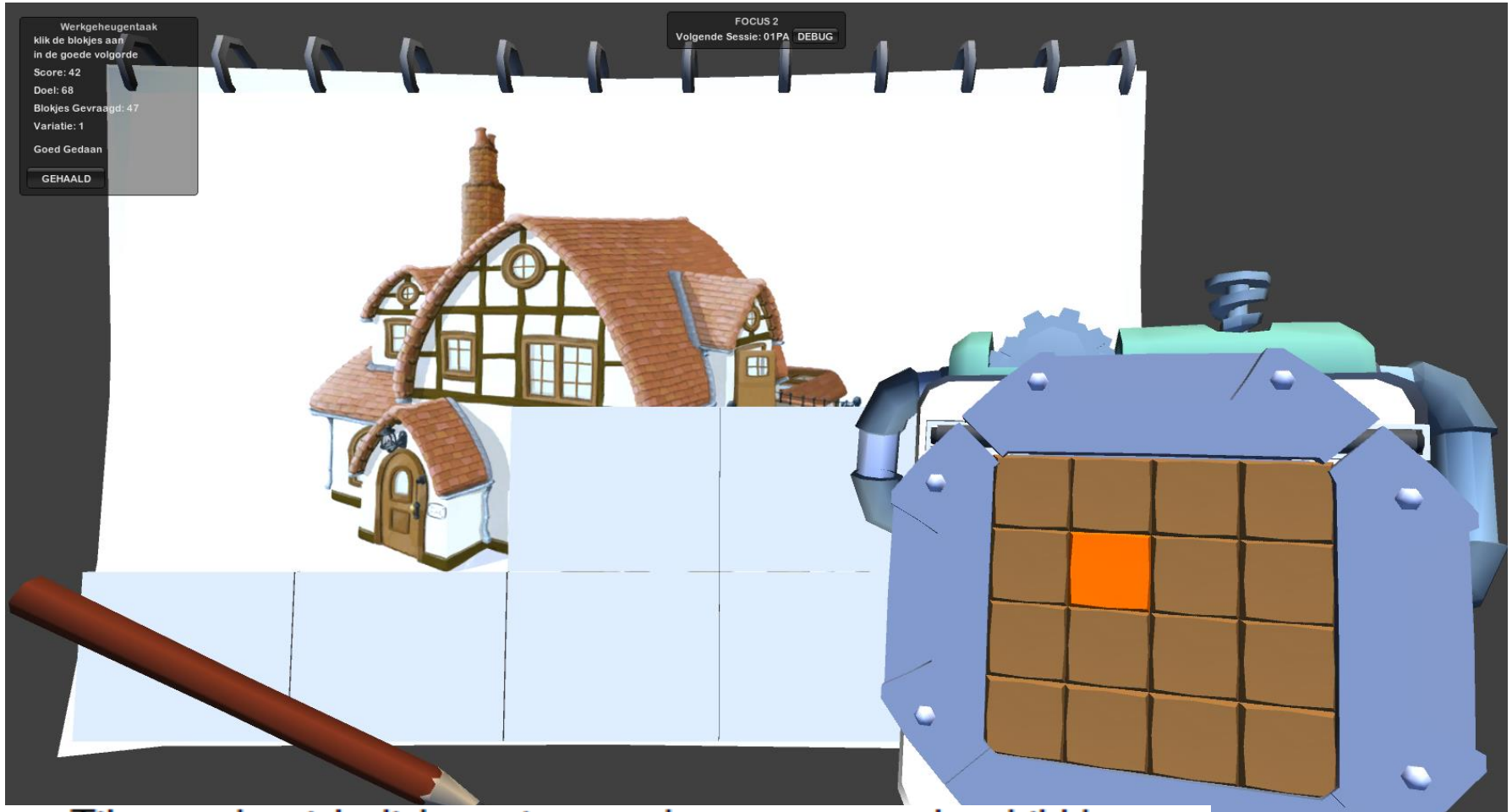
A Pilot Study of the Efficacy of a Computerized Executive Functioning Remediation Training With Game Elements for Children With ADHD in an Outpatient Setting: Outcome on Parent- and Teacher-Rated Executive Functioning and ADHD Behavior

Journal of Attention Disorders
2014, Vol. 18(8) 699–712

DOI: 10.1177/1087054712453167
jad.sagepub.com
SAGE

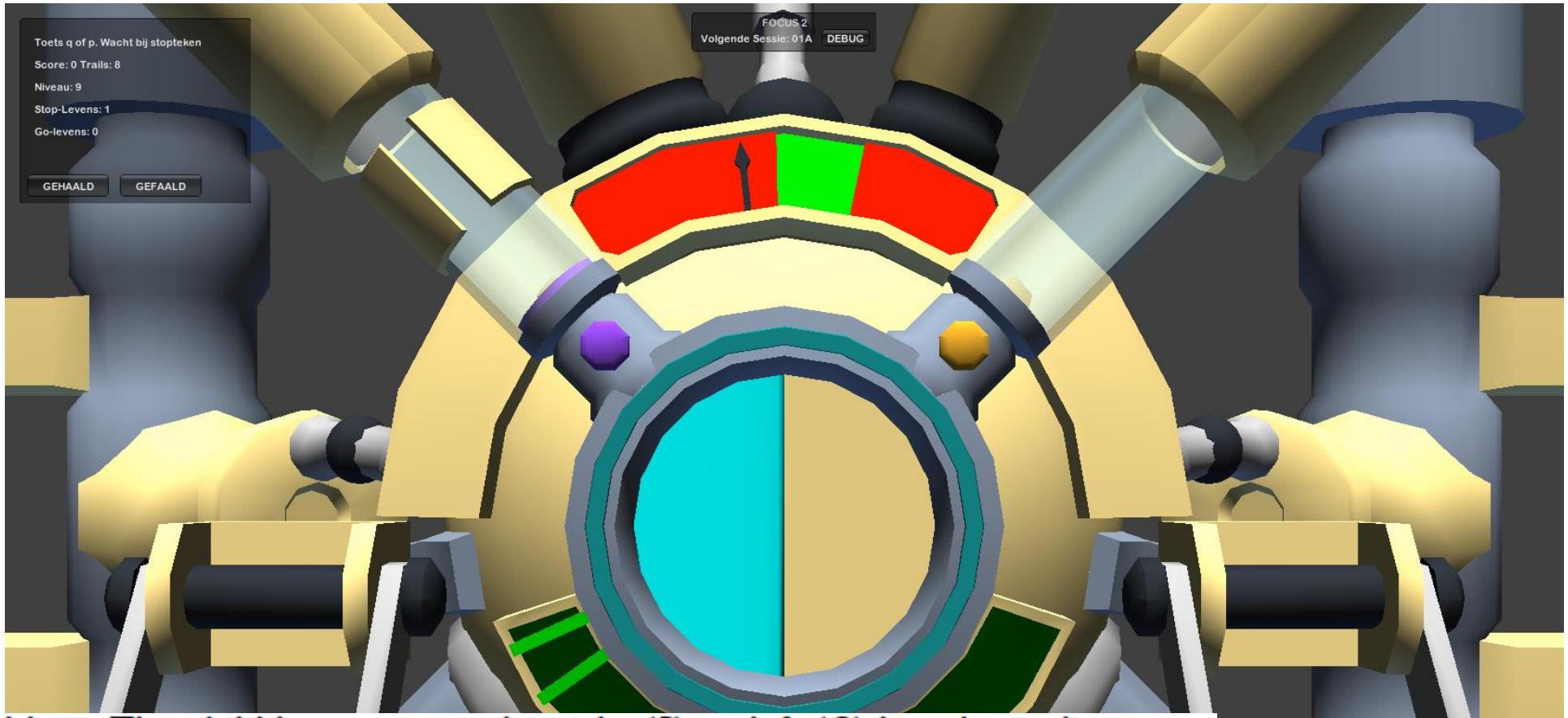
S. van der Oord[1,2], A. J.G. B. Ponsioen[3], H. M. Geurts[2], E. L. Ten Brink[3], and P. J. M. Prins[2]

WORKING MEMORY TRAINING



Note: Tiles on the right light up in a random sequence; the child has to reproduce the order of the tiles; with every correct reproduced trial, the child sees more of the reward that can be earned in the game (here painting the house of the parents of the main character Brian).

INHIBITION TRAINING



Note: The child has to press the right (*P*) or left (*Q*) key, depending on which half of the inner circle lights up; if the right half lights up blue, the *P* key has to be pressed, if left, the *Q* key (Go-trials). The child arrow (upper half of the machine) goes from the left to the right in the red area; the child has to respond when the arrow hits the green range. However, when the left or right half of the inner circle lights up red, the child has to refrain from responding (Stop-trials).

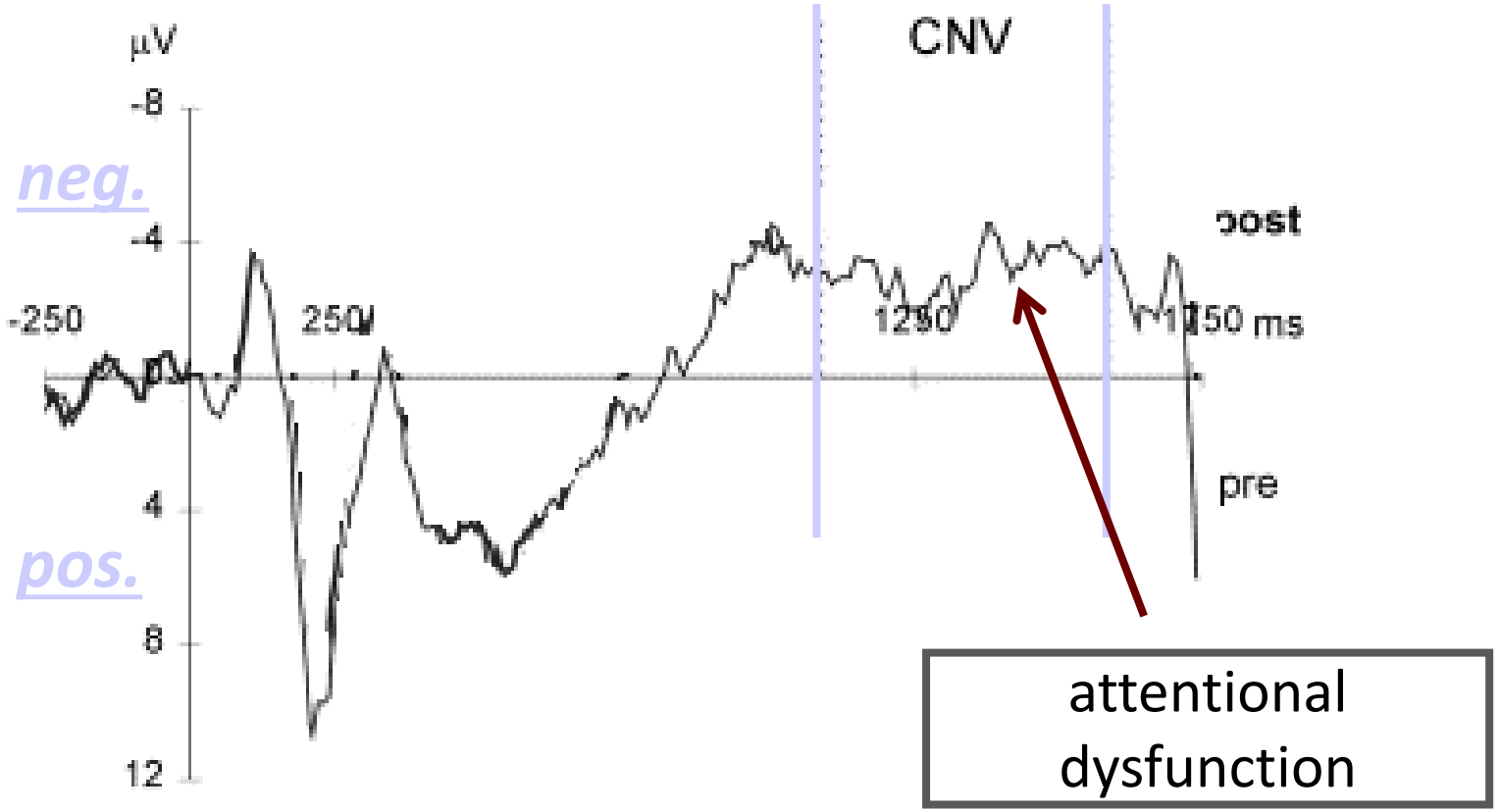
NEUROFEEDBACK

Rationale: Patients can self regulate brain activity to alter aberrant patterns using reinforcement procedures.
Intervention: EEG measures of interest are converted into visual or acoustic signals and automatically fedback in real time to the patient using computers.

Two general approaches.

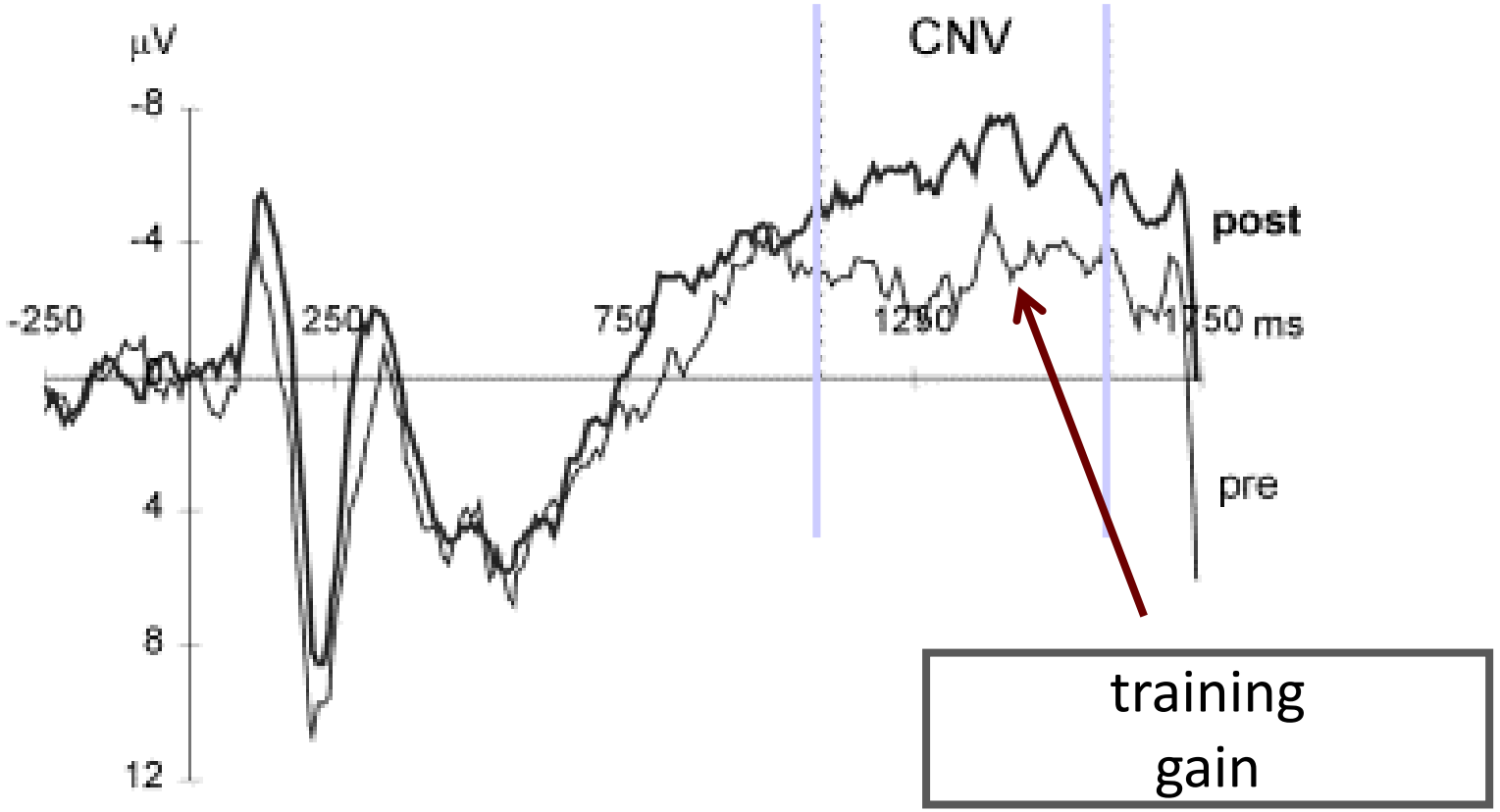
(i) **EEG frequency band training** - alter the balance between slow and fast EEG.
(ii) **Slow cortical potentials training** - regulates cortical excitation thresholds by focusing on activity elicited by external cues (so called evoked potentials).

NORMALISATION OF EVENT-RELATED POTENTIALS



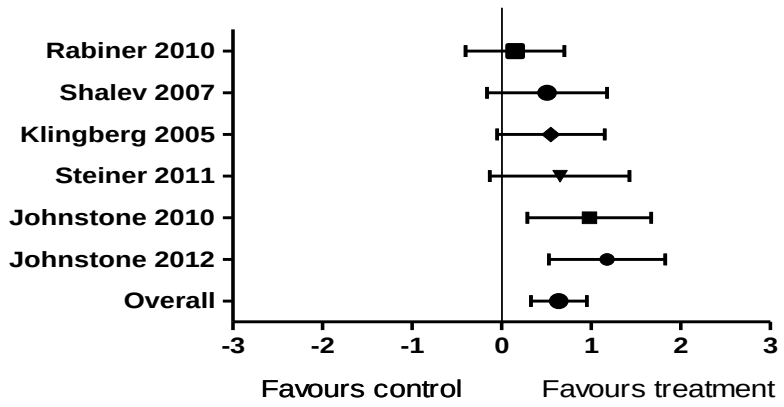
Heinrich et al. Biol Psychiatr 2004

NORMALISATION OF EVENT-RELATED POTENTIALS



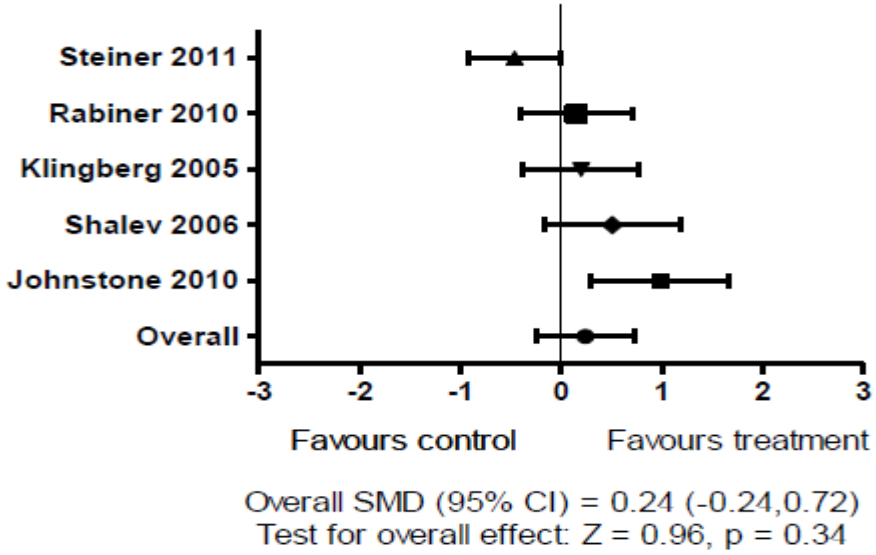
Heinrich et al. Biol Psychiatr 2004

COGNITIVE TRAINING



M-PROX

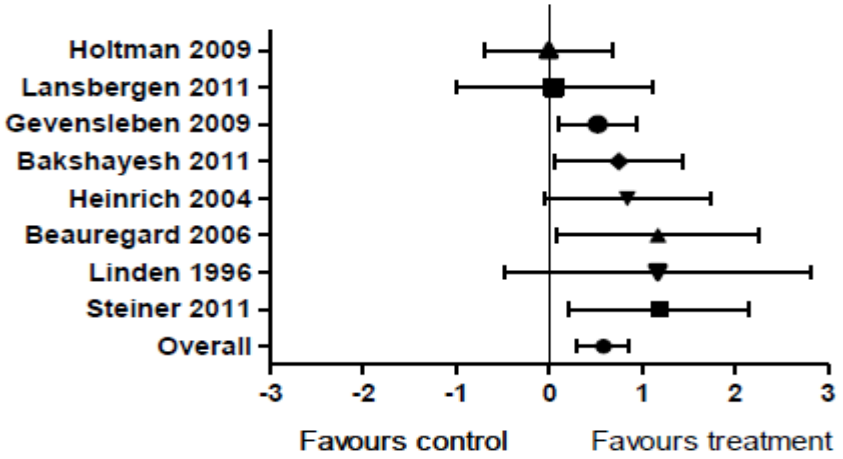
ES = 0.64*



P-BLIND

ES = 0.24

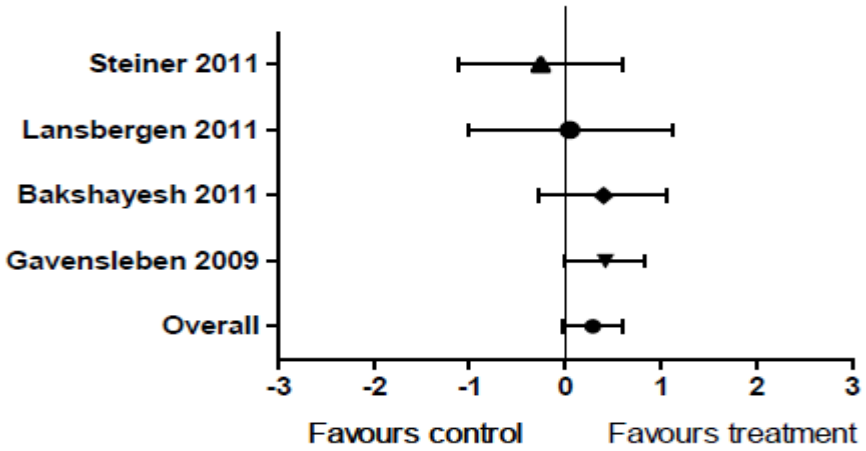
NEUROFEEDBACK



Overall SMD (95% CI) = 0.59 (0.31,0.87)
Test for overall effect: Z = 4.12, p < 0.0001

M-PROX

ES = 0.59*



Overall SMD (95% CI) = 0.29 (-0.02,0.61)
Test for overall effect: Z = 1.81, p = 0.07

P-BLIND

ES = 0.29

INITIAL CONCLUSION

"Better evidence for efficacy from blinded assessments is required for behavioral interventions, neurofeedback, cognitive training, ….before they can be supported as treatments for core ADHD symptoms." (Sonuga-Barke et al., 2013).

Journal of the American Academy of
CHILD & ADOLESCENT
PSYCHIATRY

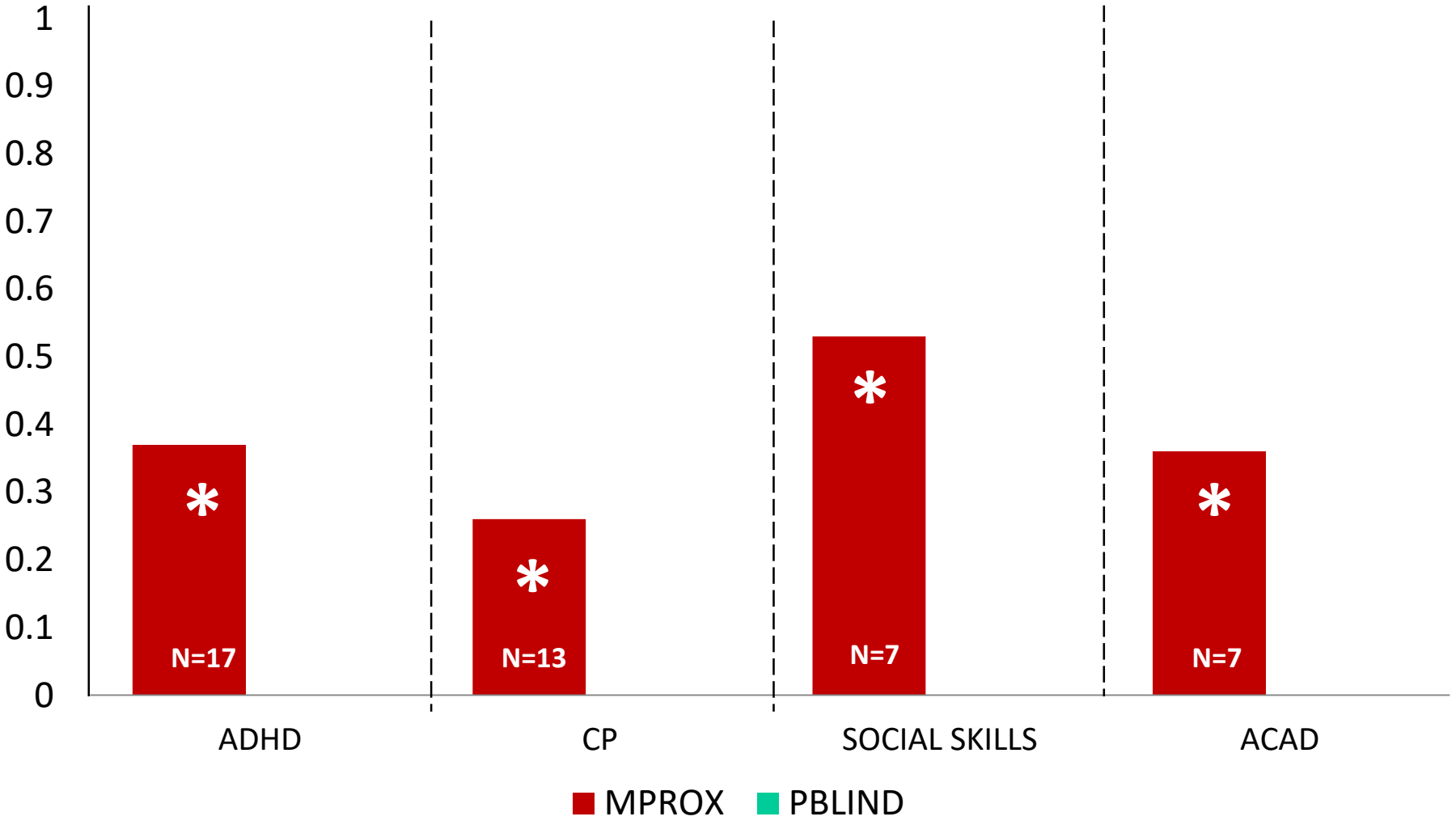
Behavioral Interventions in Attention-Deficit/ Hyperactivity Disorder: A Meta-Analysis of Randomized Controlled Trials Across Multiple Outcome Domains

UPDATES AND EXTENSIONS

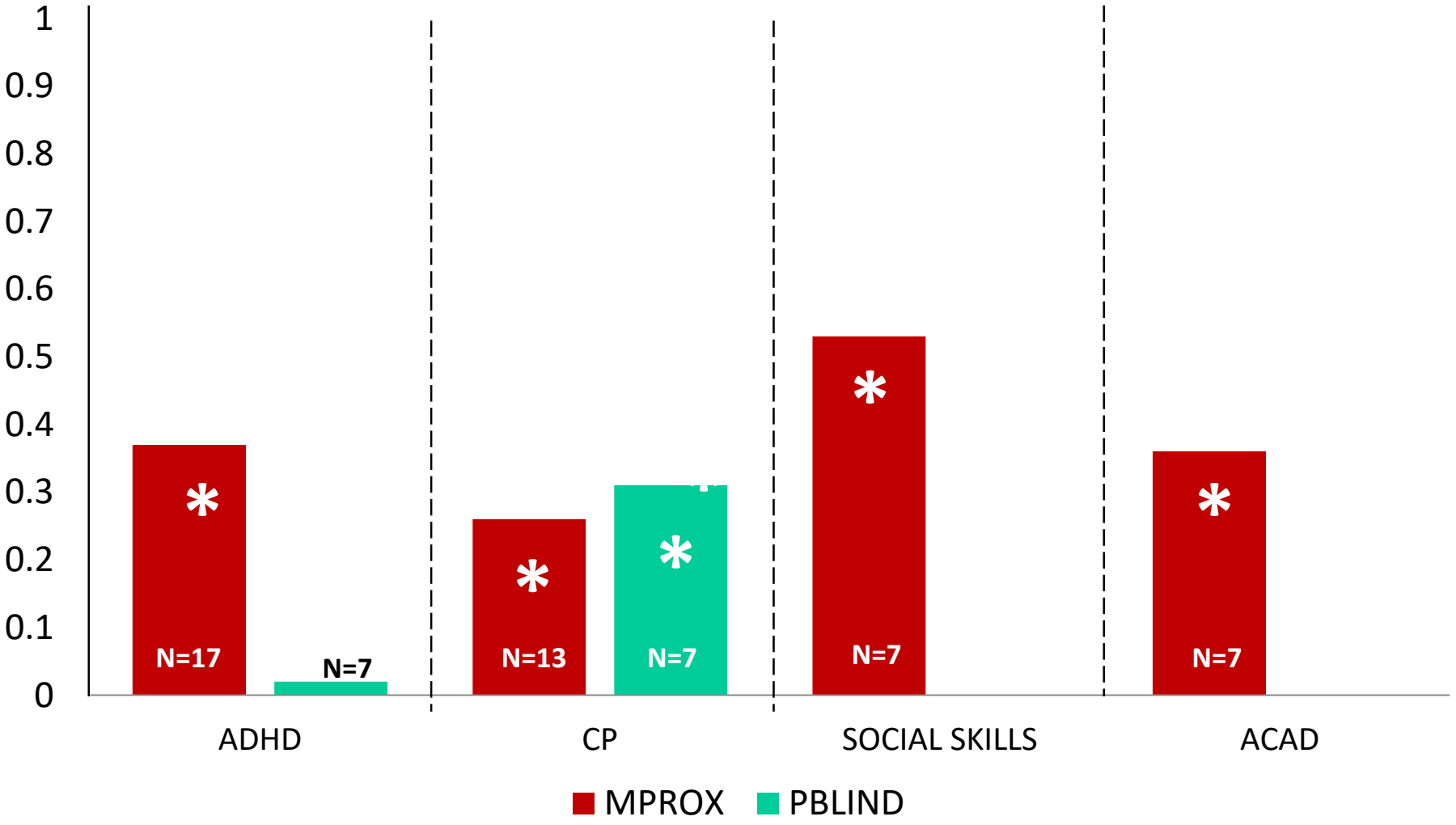
BEHAVIOURAL INTERVENTIONS

and child ADHD (SMD 0.35), conduct problems (SMD 0.26), social skills (SMD 0.47), and academic performance (SMD 0.28). With probably blinded assessments, significant effects persisted for parenting (SMD for positive parenting 0.63; SMD for negative parenting 0.43) and conduct problems (SMD 0.31). **Conclusion:** In contrast to the lack of blinded evidence of ADHD symptom decrease, behavioral interventions have positive effects on a range of other outcomes when used with patients with ADHD. There is blinded evidence that they improve parenting and decrease childhood conduct problems. These effects also may feed through into a more positive parenting self-concept but not improved parent mental well-being. J. Am. Acad. Child Adolesc. Psychiatry, 2014;53(8):835–847. **Key Words:** ADHD, parenting, intervention, conduct

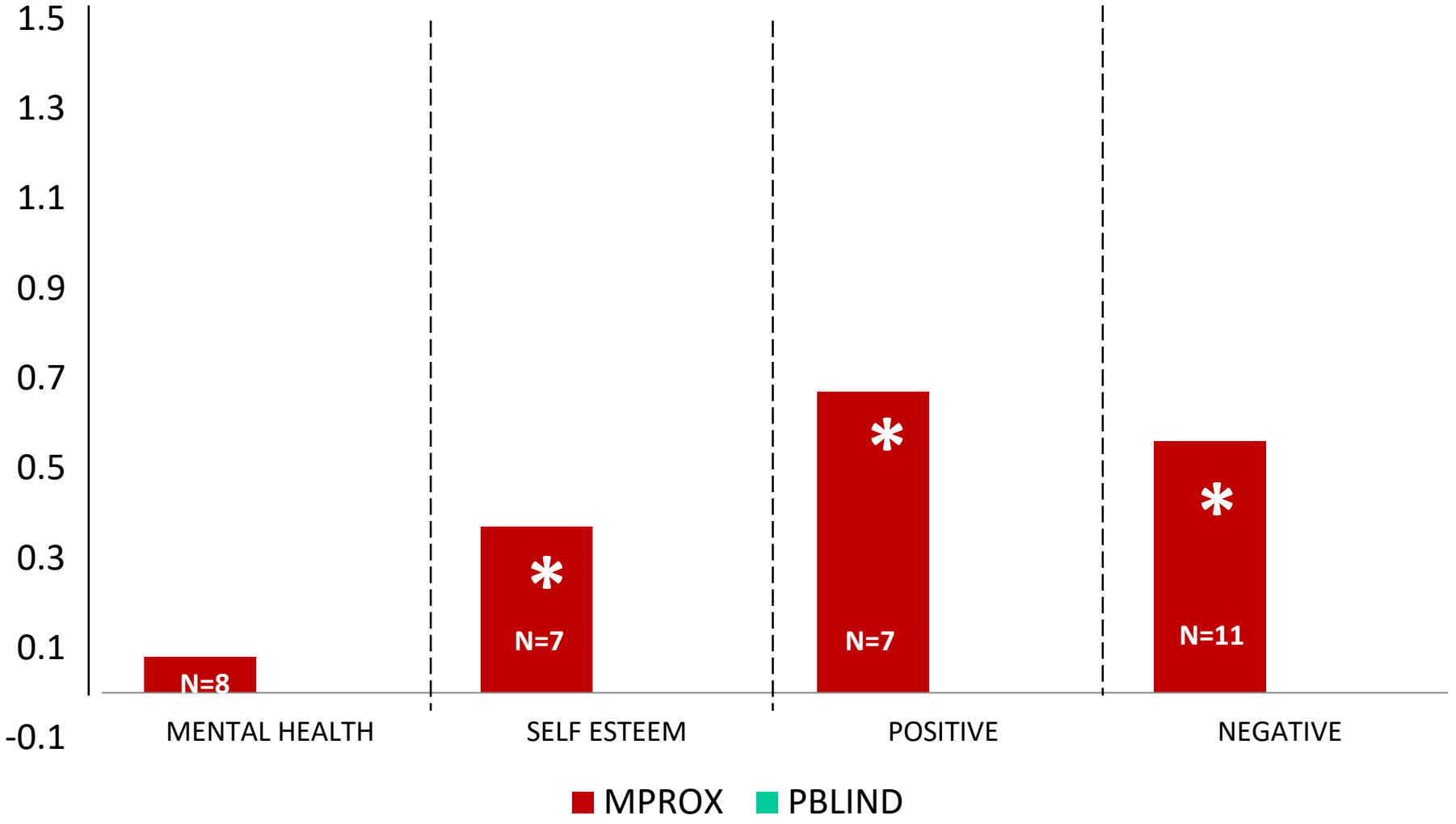
CHILD OUTCOMES – SUMMARY)



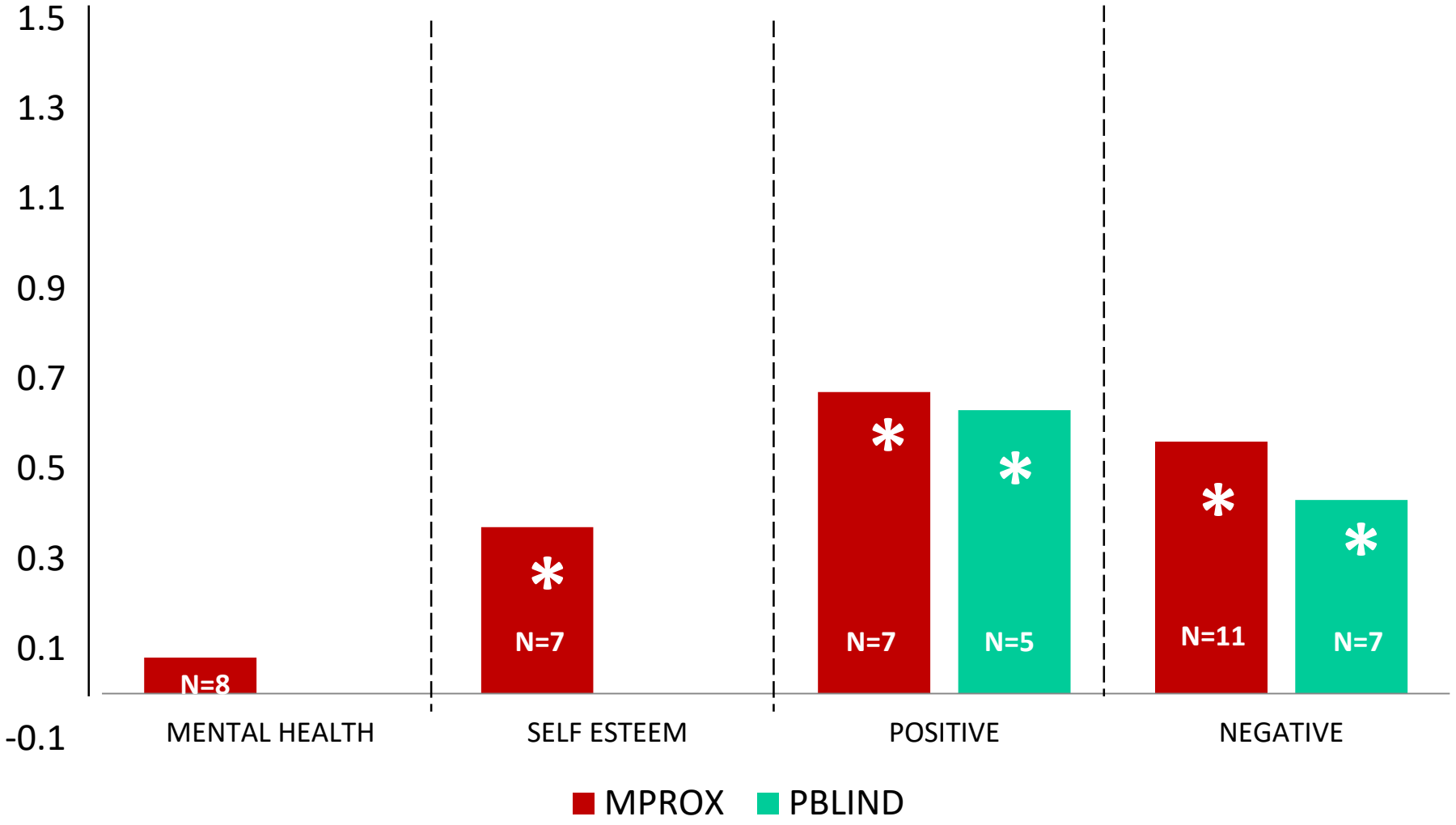
CHILD OUTCOMES – SUMMARY



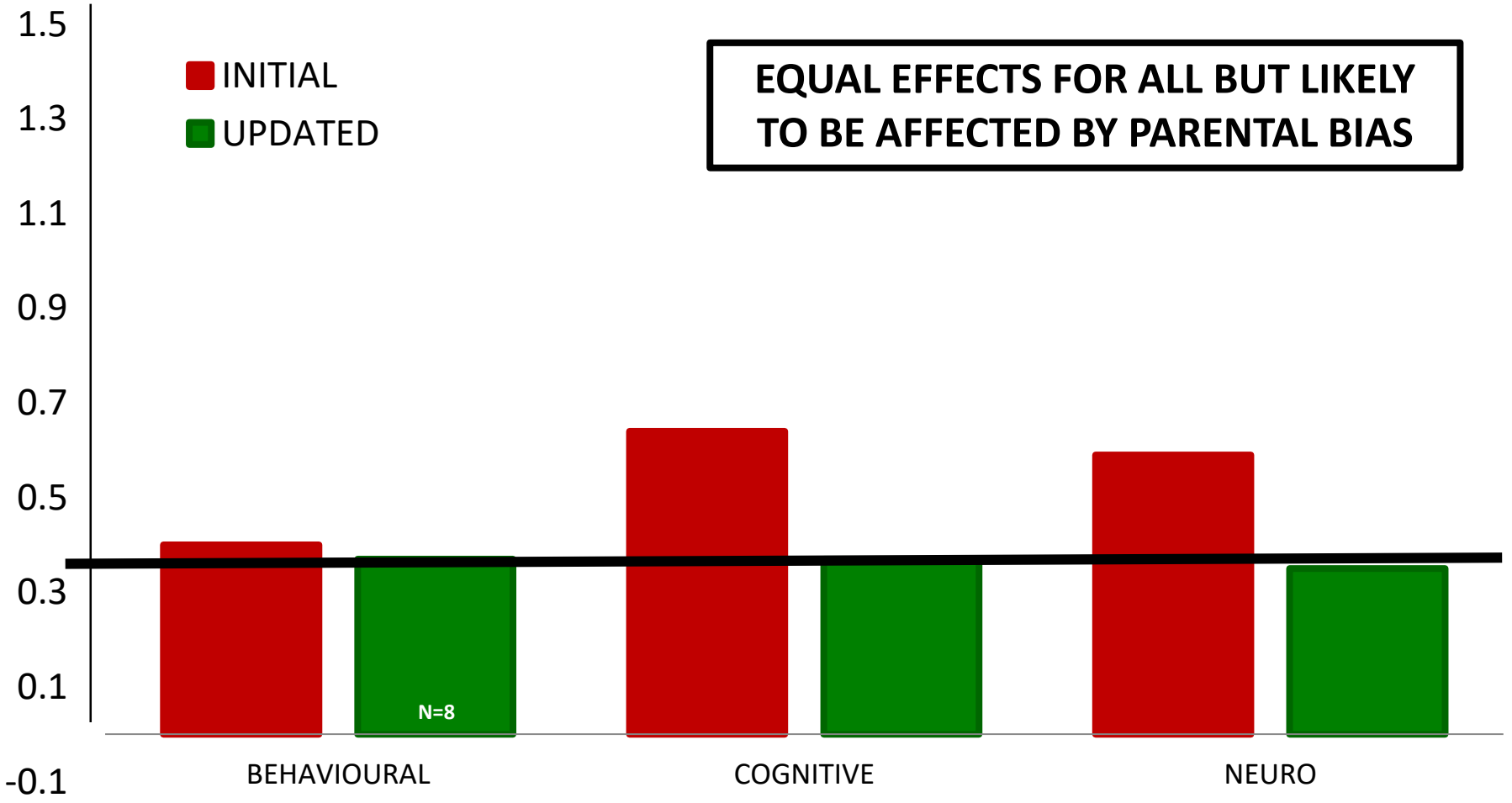
ADULT OUTCOMES – SUMMARY



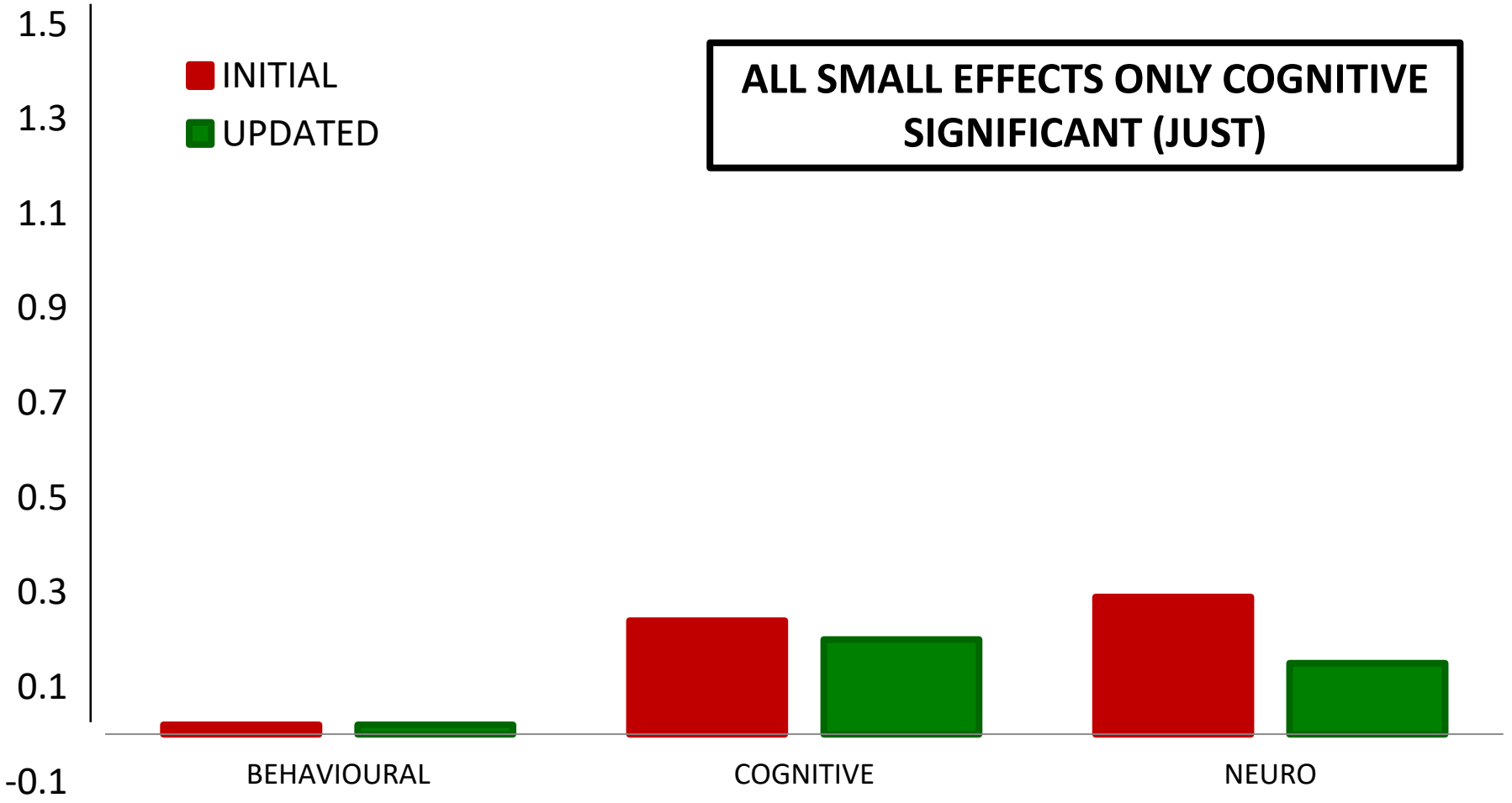
ADULT OUTCOMES – SUMMARY



INITIAL AND REVISED ESTIMATES (MPROX)



INITIAL AND REVISED ESTIMATES (PBLIND)



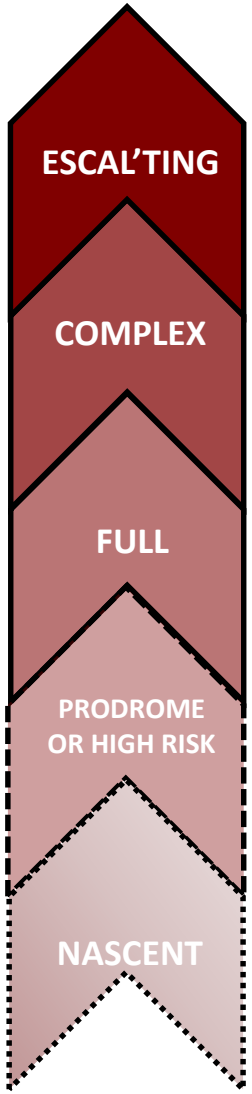
DO NON-PHARMA ADHD TREATMENTS WORK? DEPENDS WHAT YOU MEAN! DEPENDS WHO YOU ASK!

- Do they control core ADHD symptoms?
- Do parents think things have improved?
- Do they reduce other common comorbidities
- Do they improve everyday functioning?
- Do they change parent's attitudes/behaviours to child?
- Do they promote parental wellbeing?
- Do they strengthen family functioning?
- Do they increase QoL in the long run?

HOW CAN PSYCHOLOGICAL INTERVENTIONS BE IMPROVED?

WHAT DOES THE DEVELOPMENTAL PERSPECTIVE INDICATE?

WILL INTERVENING EARLY OPTIMISE BRAIN PLACTIVITY AND INCREASE LONG TERM EFFECTS ON CORE DEFICITS?


ESCAL'TING
COMPLEX
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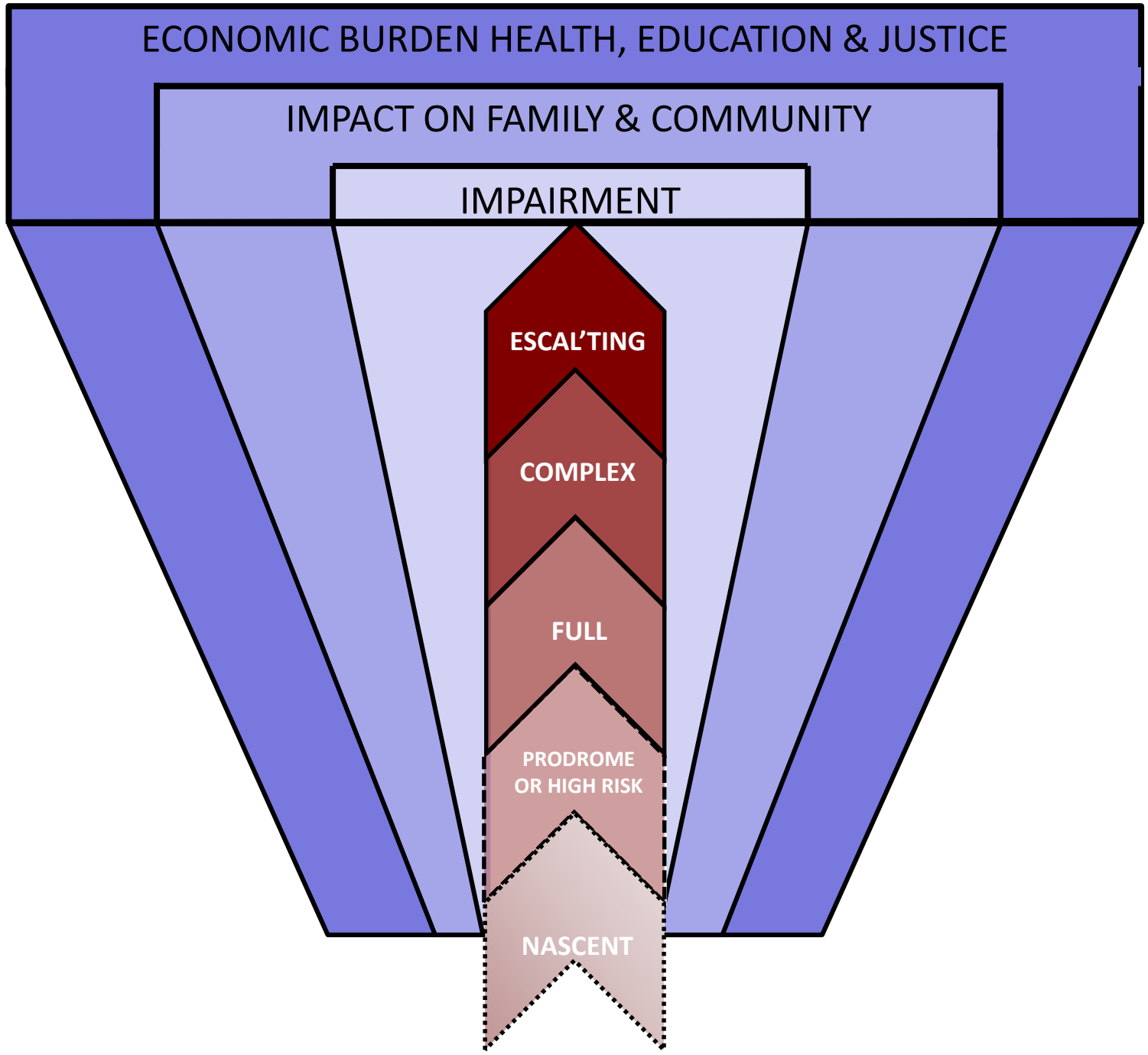
PRODROME
OR HIGH RISK
NASCENT


ECONOMIC BURDEN HEALTH, EDUCATION & JUSTICE
IMPACT ON FAMILY & COMMUNITY
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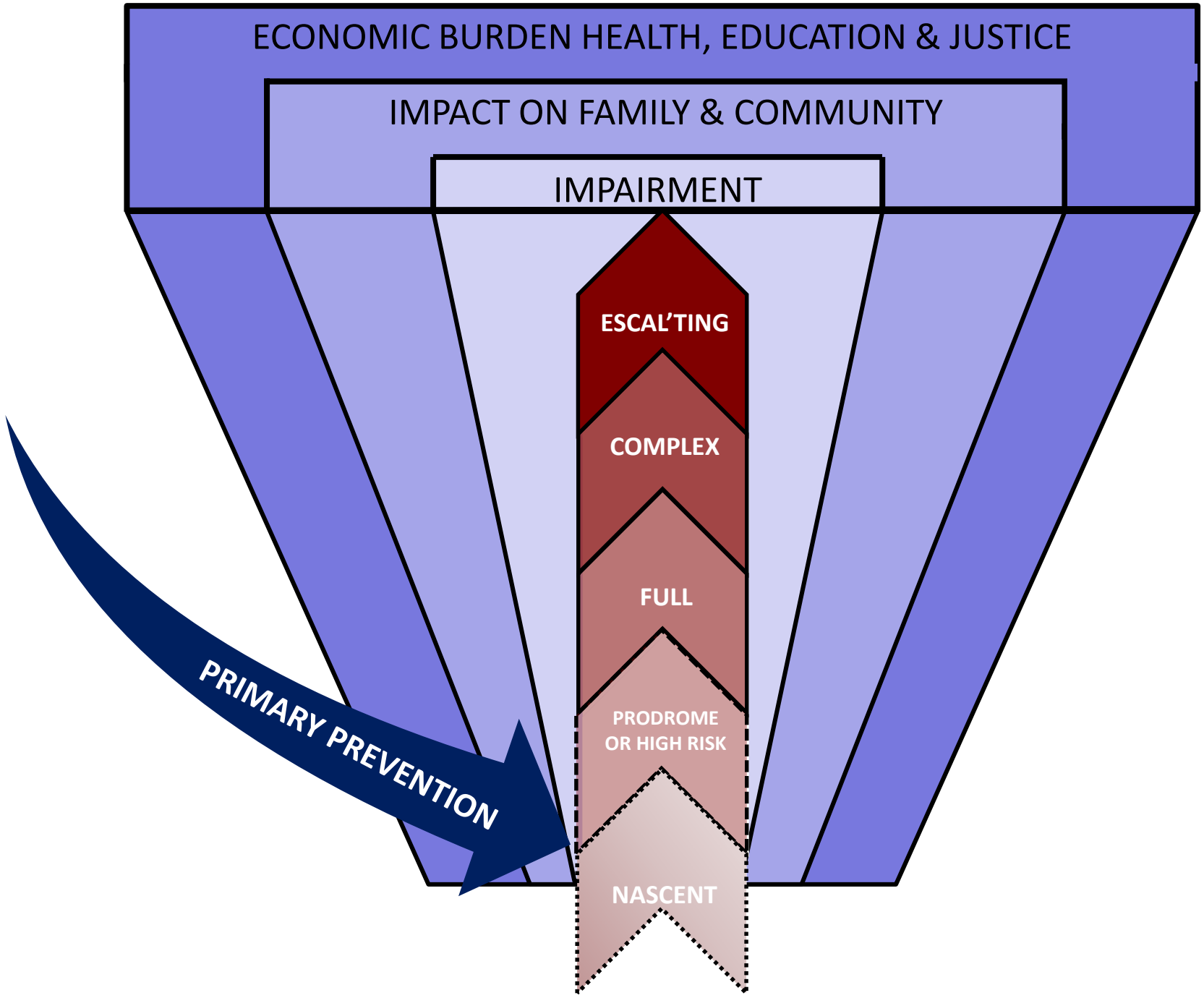
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IMPACT ON FAMILY & COMMUNITY
IMPAIRMENT
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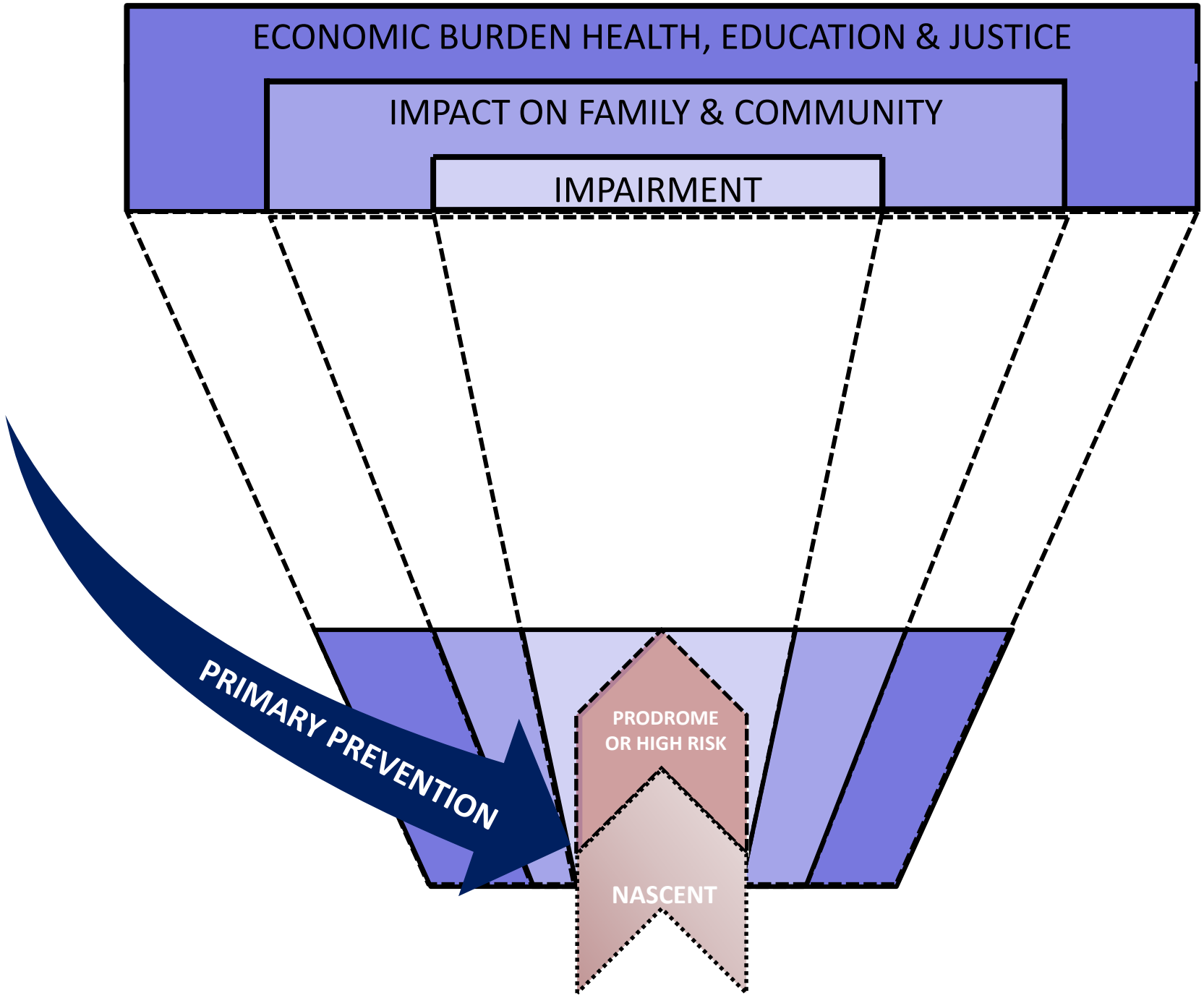
COMPLEX
FULL
PRODROME
OR HIGH RISK
NASCENT
PRIMARY PREVENTION


ECONOMIC BURDEN HEALTH, EDUCATION & JUSTICE
IMPACT ON FAMILY & COMMUNITY
IMPAIRMENT
PRIMARY PREVENTION
PRODROME
OR HIGH RISK
NASCENT

IS PREVENTION BETTER THAN CURE?

Over time, ADHD becomes more difficult to treat – behavioural habits engrained - comorbidities develop.

Lesion studies, computational modelling, animal models and neuroimaging show neural plasticity is greater, early in development

Prevention neuroscience idea - cognitive systems can be strengthened before disorder onset in individuals at high risk so that liklihood of disorder, its severity and persistence is reduced.

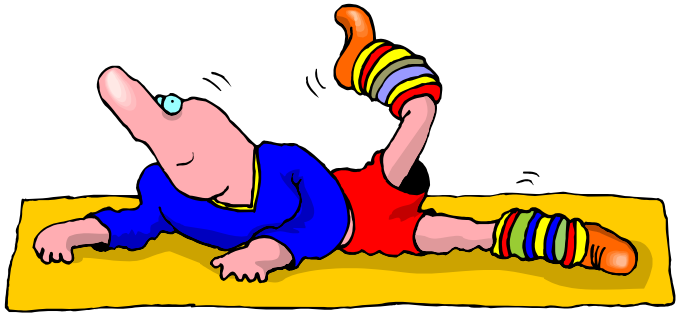
PREVENTION NEUROSCIENCE
PROTOTYPE #1 - HALPERIN & HEALEY'S ENGAGE

- Principle – Incorporating cognitive training into every day parent-child interactions with optimise gains in preschool.
- Targets
  - Working Memory
  - Attentional Control
  - Motor Skills Development
  - Pattern Recognition/Visuospatial Organization
  - Inhibitory Control
  - Emotional Control
- Parents serve as primary delivery mechanism
  - Learn to engage in fun play with their children

Green Games – Working Memory

2) What's Under There?

1) Shopping



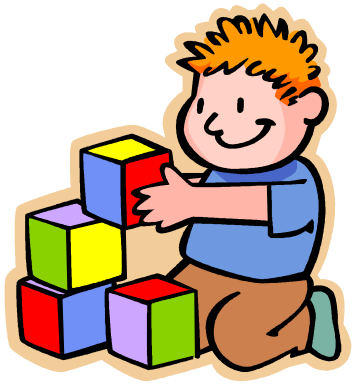
3) Copy Me

4) Memory Game

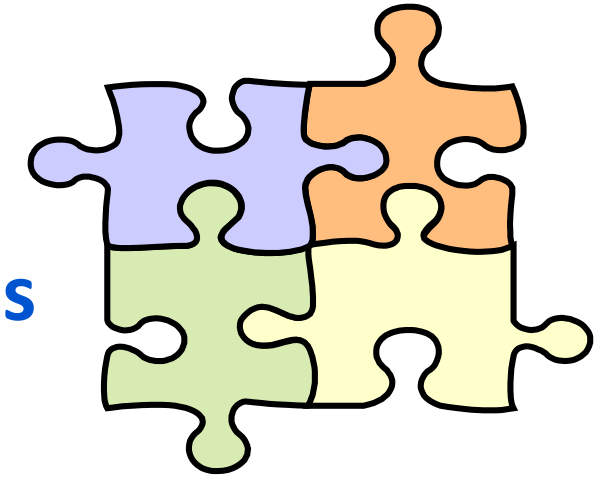
5) Remember the Treasure

Yellow Games – Visual-Spatial/Pattern Recognition and Organization

1) Blocks



2) Puzzles



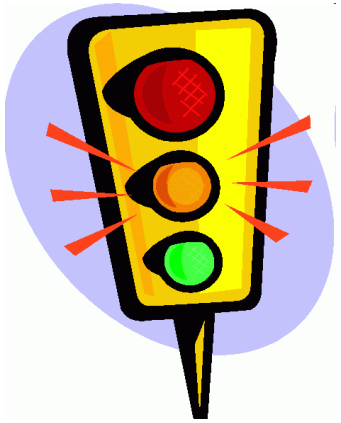
3) Beads

4) Track It

Blue Games – Inhibitory Control

1) Freeze Dance

2) Puppet Says

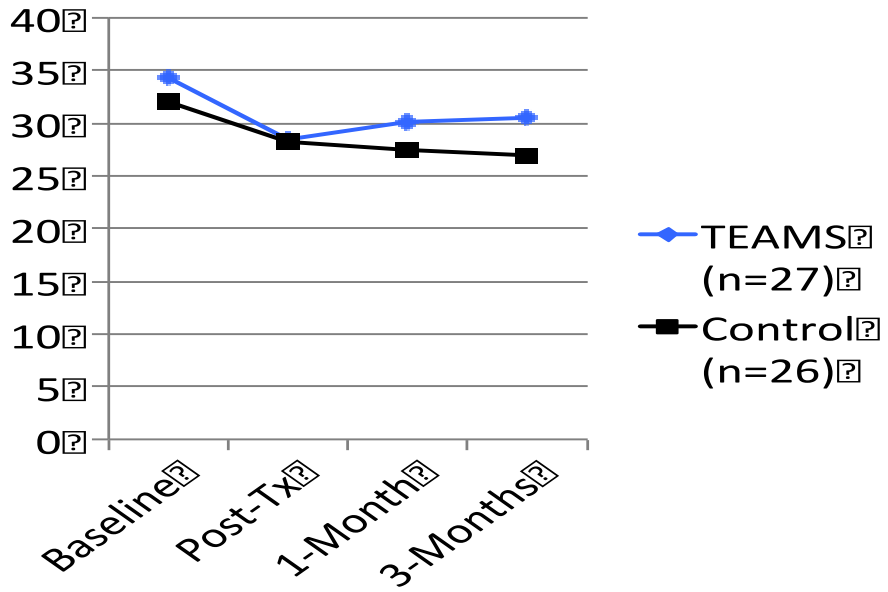


3) Red Yellow Green

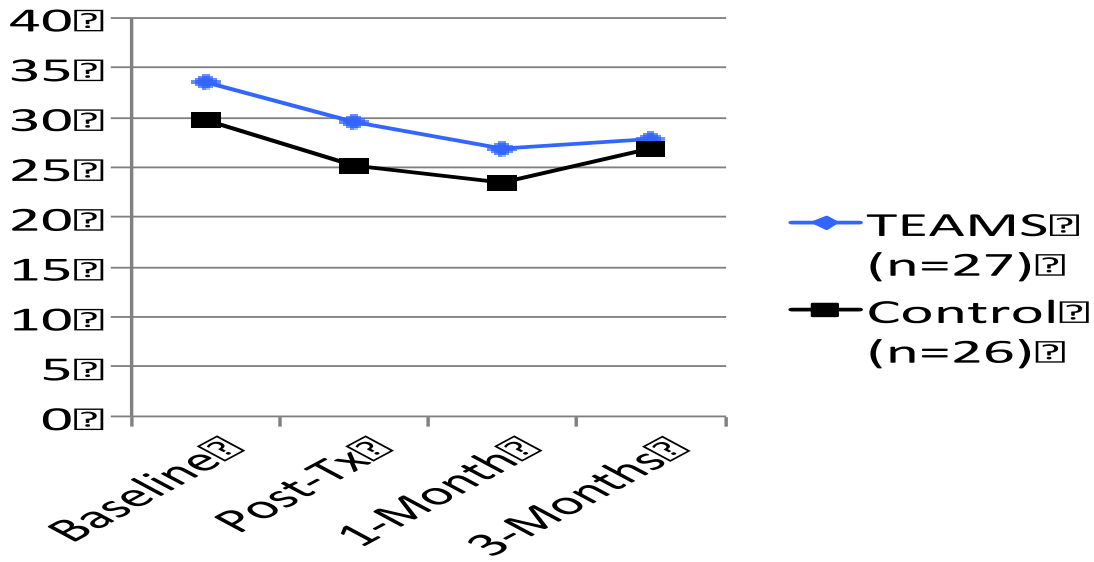
4) Taboo

RESULTS – ADHD

Parent Report*



Teacher Report*



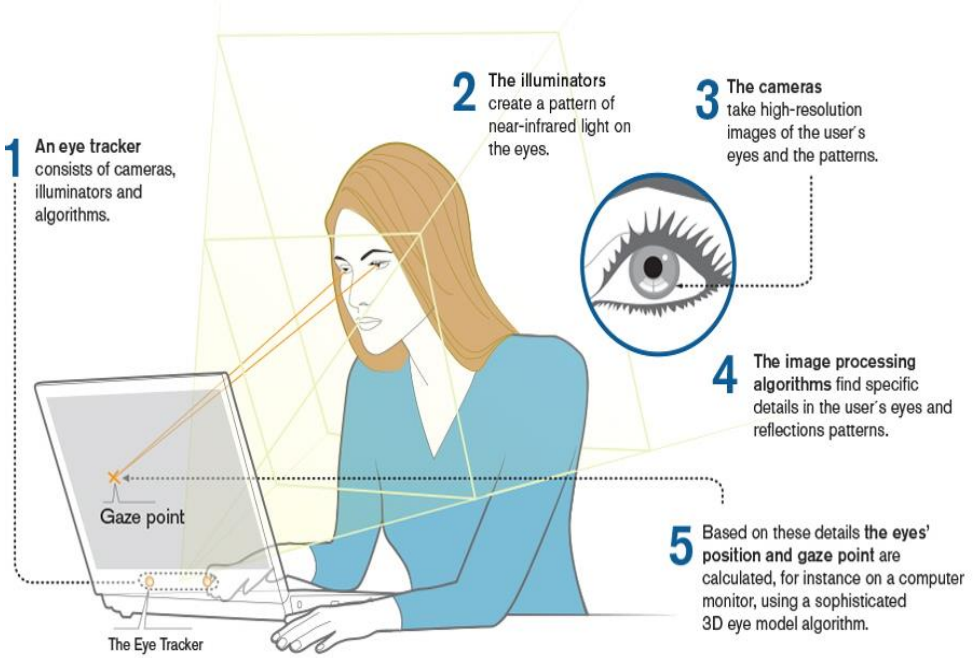
*Main effects Time: $p < .05$

EVIDENCE NOT COMPELLING SHOULD WE GO YOUNGER

PREVENTION NEUROSCIENCE

PROTOTYPE #2 – WASS' GAZE CONTINGENT ATTENTION TRAINING FOR INFANTS

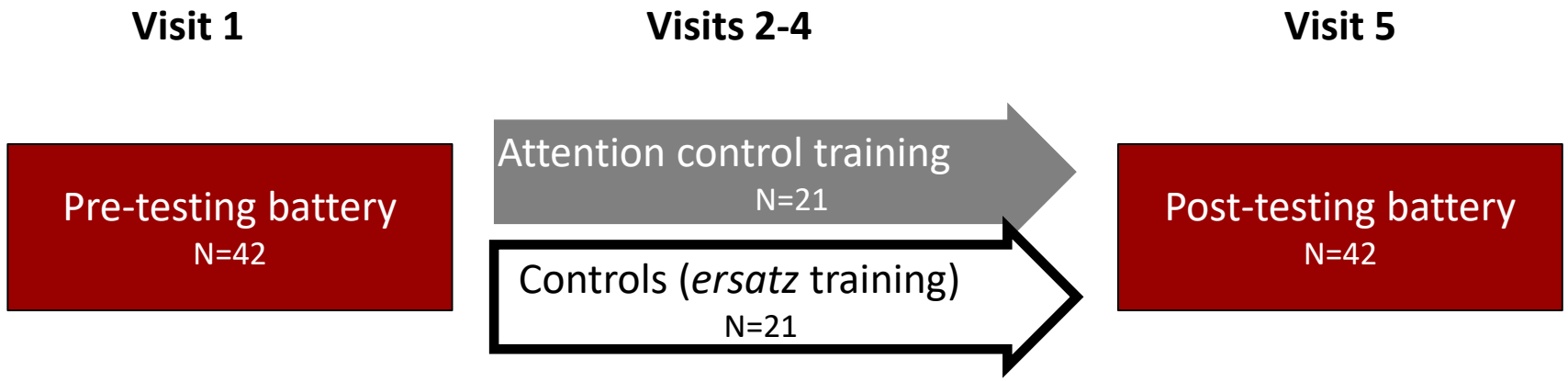
Principle – Sophisticated reflection-based eye-tracking technology allows the direct training of attention through gaze contingent interaction even at this age.



TASK – SUSTAINED ATTENTION

STUDY 1 - DESIGN

42 typical 12-month-old infants attend 5 visits over 2 weeks:

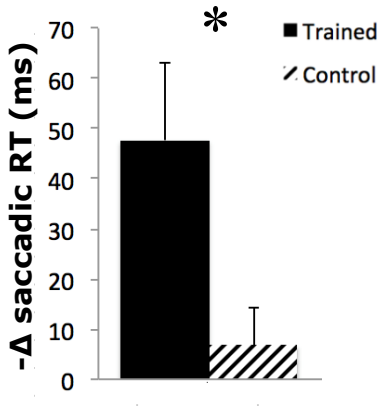


Avg. 77 minutes' training per participant.

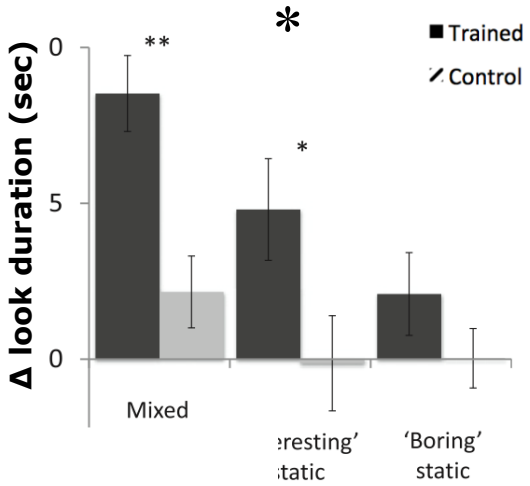
Wass, Porayska-Pomsta & Johnson, 2011 – *Current Biology*

STUDY 1 - RESULTS

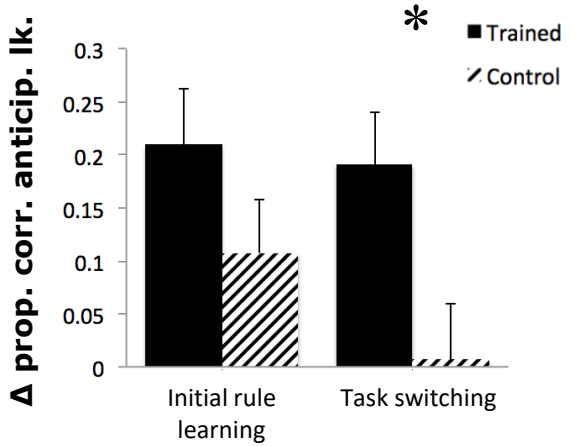
Saccadic reaction time

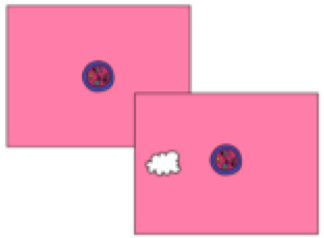


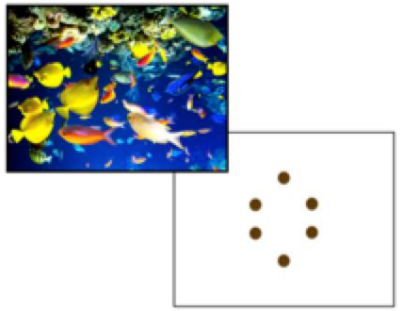
Visual sustained attention

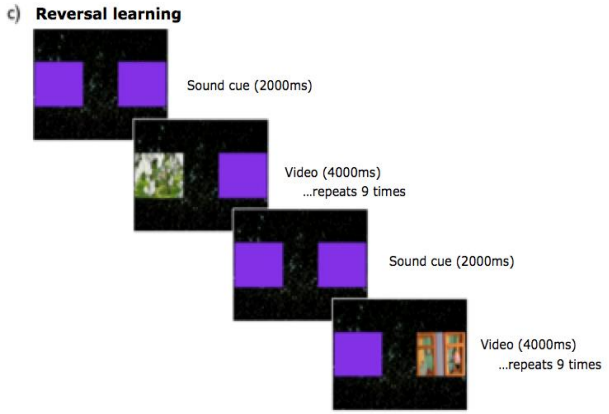


Reversal learning









CAN THIS REDUCE THE RISK OF ADHD IN CHILDREN AT RISK FOR ADHD?

INTERSTAARS

Birkbeck

- Mark Johnson
- Emily Jones
- Simona Salomone
- Tim Smith
- Luke Mason

University of Southampton

- Edmund Sonuga-Barke
- Anna Hunt
- Martin Ruddock

University of East London

- Sam Wass

King's College London

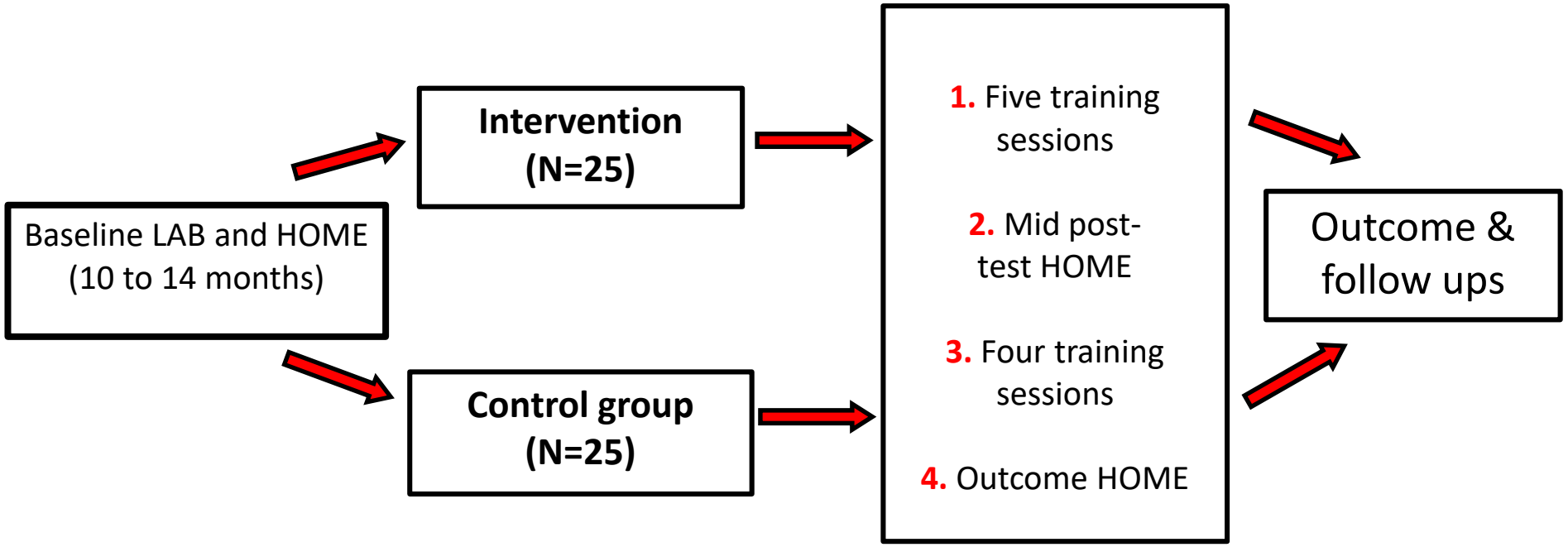
- Patrick Bolton
- Tony Charman
- Andrew Pickles
- Emily Robinson
- Abigail Runicles

Our funders: MQ Transforming Mental Health and the Medical Research Council

DESIGN

Participants

- Fifty 10 – 14 month old infants with a first degree family member with ADHD; increased familial risk for ADHD.



Follow up data collected at 2 and 3 years of age

SUMMARY

- Approaches that target symptoms such as PT are valuable in many ways – but probably don't target core symptoms.
- More translational approaches such as NF and CT currently lack evidence.
- Approaches targeting multiple processes my be more effective.
- Taking a prevention science approach may improve matters.
- *Game based naturalistic approaches with pre-schoolers so far have limited effects.*
- *Gaze controlled training in infancy seems to improve cognitive control in the short term.*
- *Further work is required to optimise the impact of these approaches to target core ADHD symptoms.*