ADDITUDE
Strategies and Support *for* ADHD & LD

The Brain-Behavior Connection

In Children with ADHD

https://youtu.be/4z9ZM_q14pY

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Strategies and Support *for* ADHD & LD

meet today's expert speaker:

Joel Nigg, Ph.D.

Joel Nigg, Ph.D., is a clinical psychologist and a professor in the departments of psychiatry and behavioral sciences at OHSU. He directs the OSHU ADHD Research program and is also director of the division of psychology. Author of *What Causes ADHD? Understanding What Goes Wrong and Why*. Dr. Nigg has published nearly 200 peer-reviewed scientific papers related to the neuropsychological , cognitive, and temperamental correlates of child ADHD, to ADHD genetics, and in particular for this talk, to MRI-based research and theoretical interpretations of brain development in ADHD.

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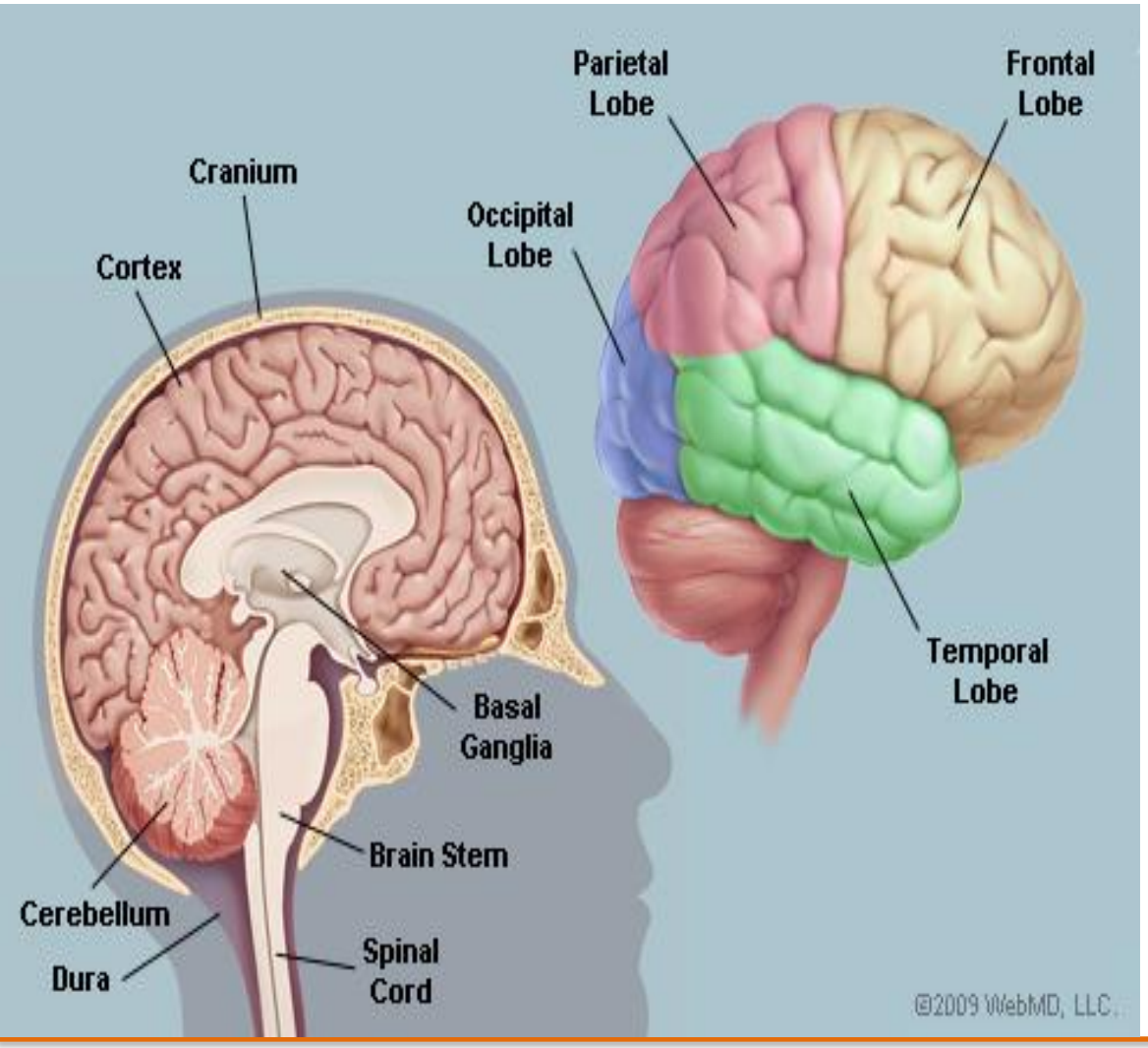
OUTLINE

- Neuroscience basics and relevance to ADHD
- Top-down/bottom-up self-regulation of attention, emotion, behavior
- Attention and ADHD brain
- Emotion and ADHD brain
- Individual variation in ADHD
- Summary

HOW DOES THE BRAIN WORK IN CONCEPT?

Orientation: Basic brain map



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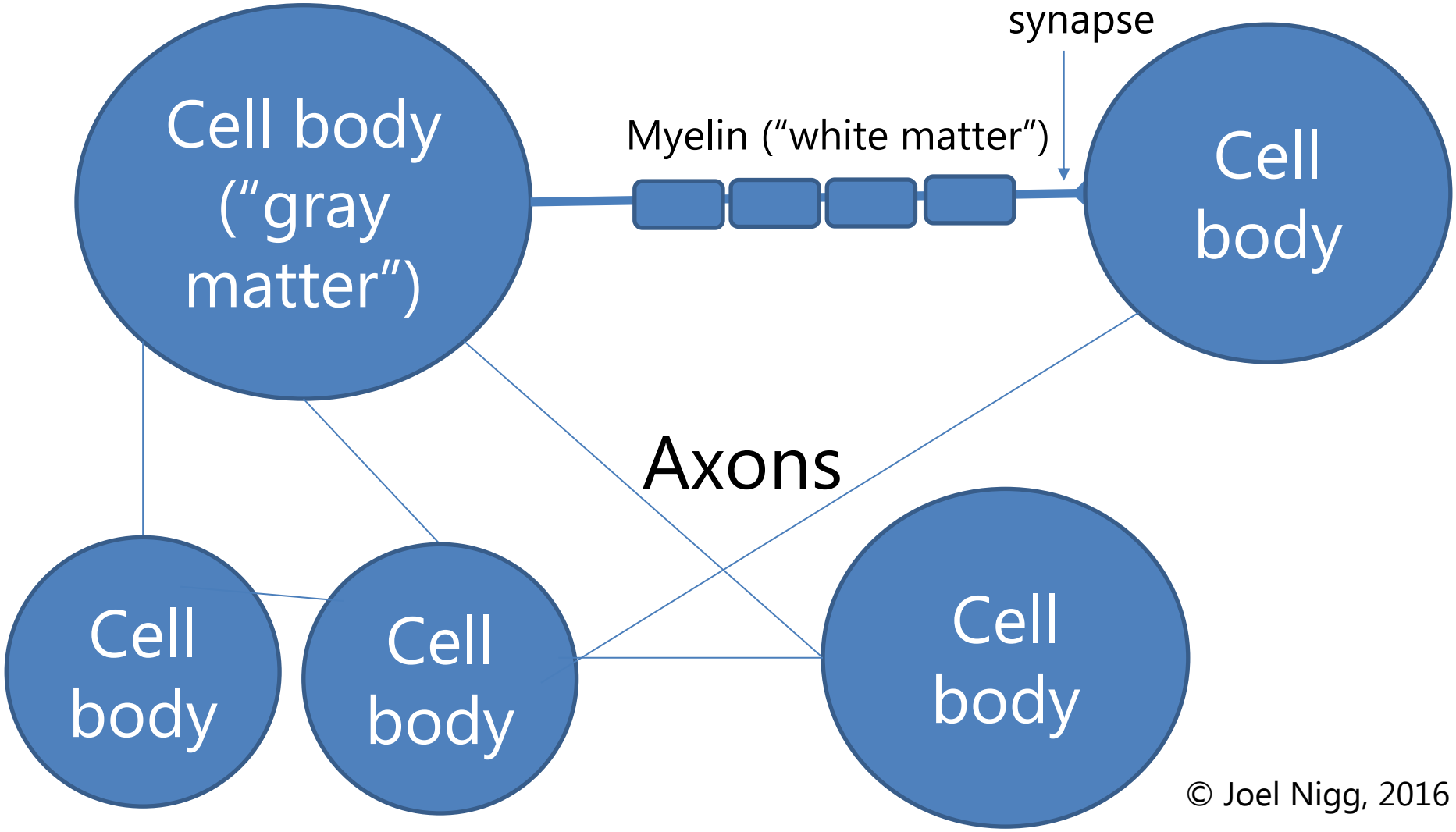
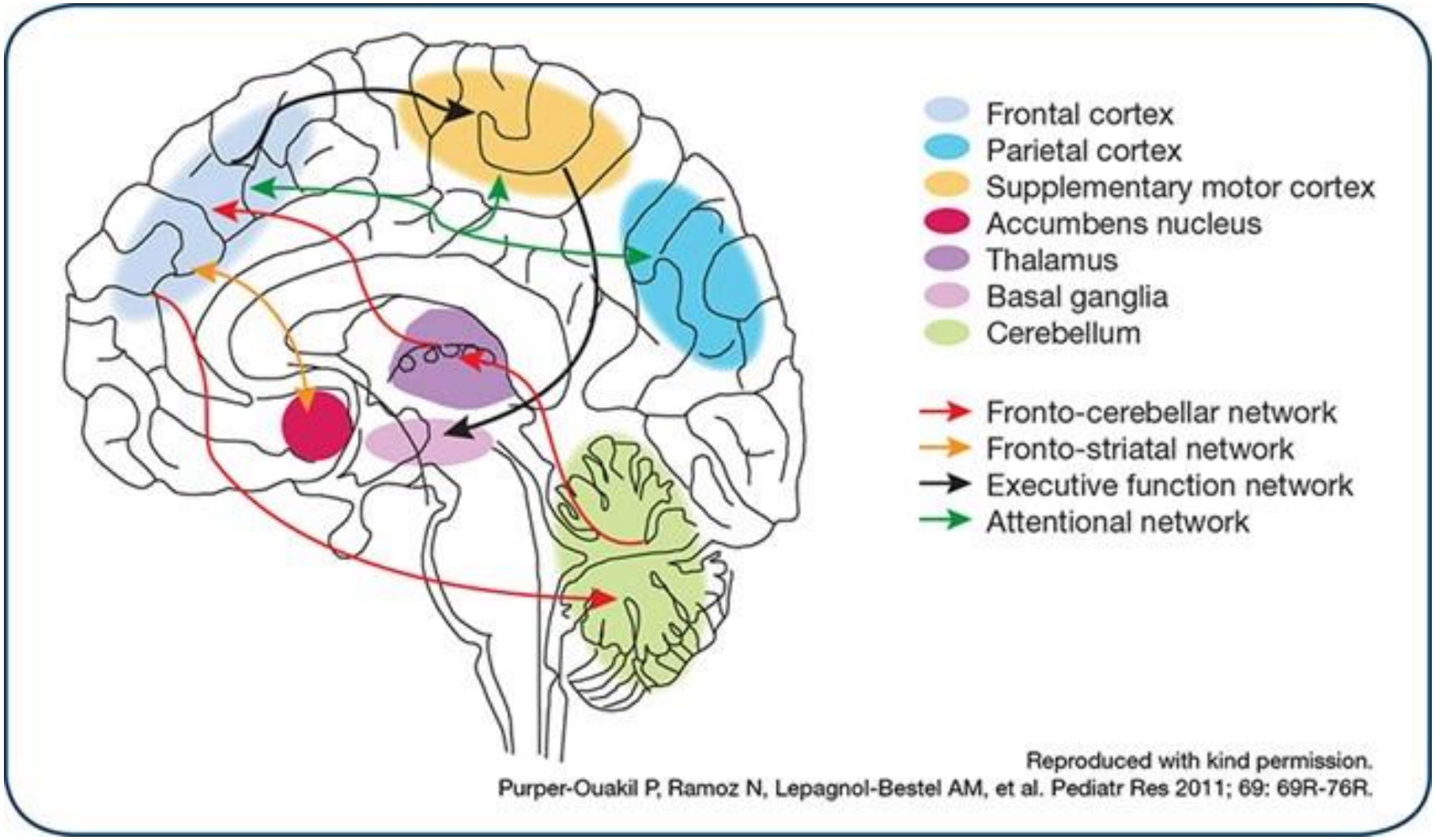
Neuron and Network Concept

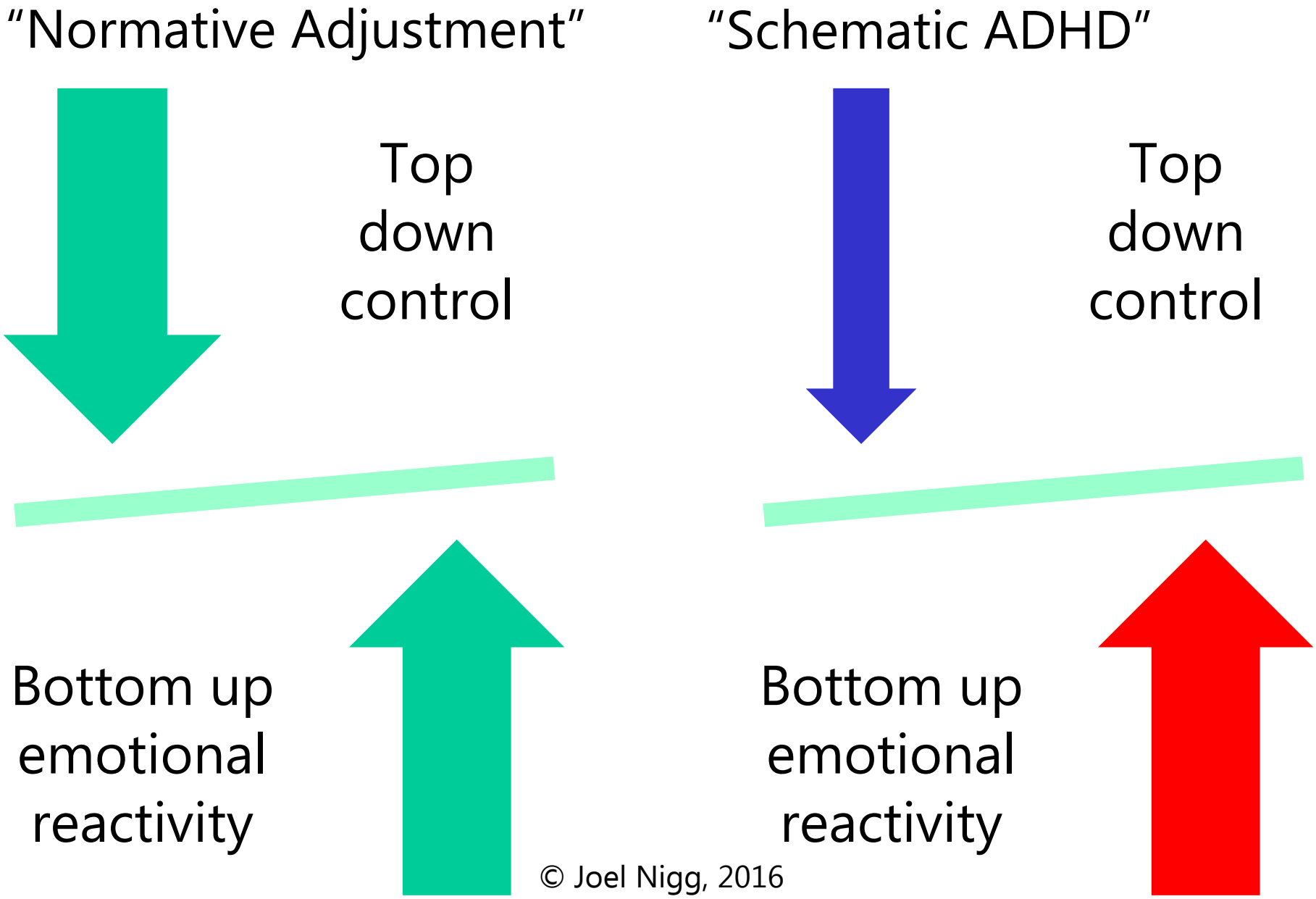


Critical circuits and networks ADHD Brain



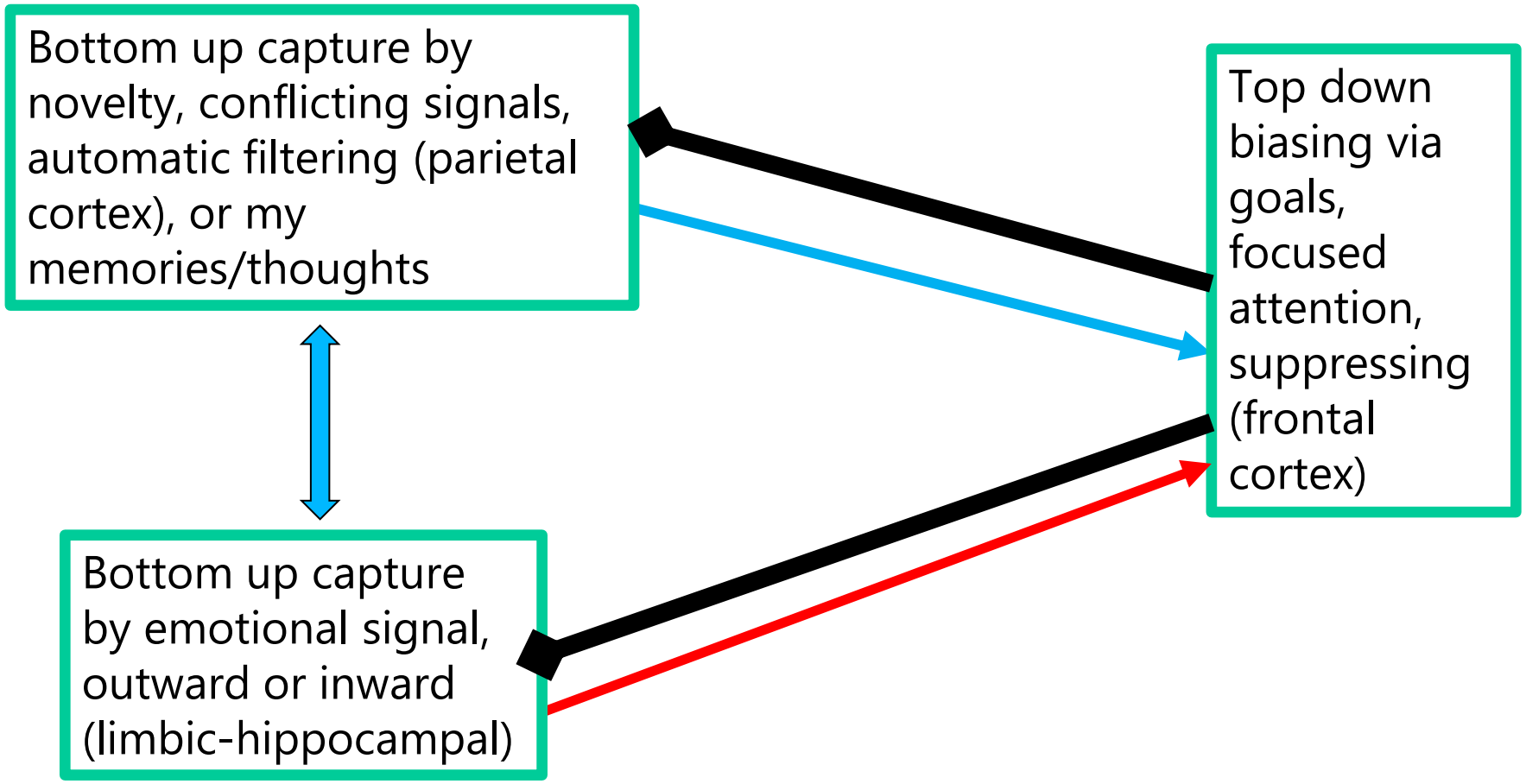
Reproduced with kind permission.
Purper-Ouakil P, Ramoz N, Lepagnol-Bestel AM, et al. Pediatr Res 2011; 69: 69R-76R.

HOW DOES IT WORK IN PRACTICE FOR SELF-REGULATION? PRINCIPLE OF TOP-DOWN/BOTTOM UP BALANCING

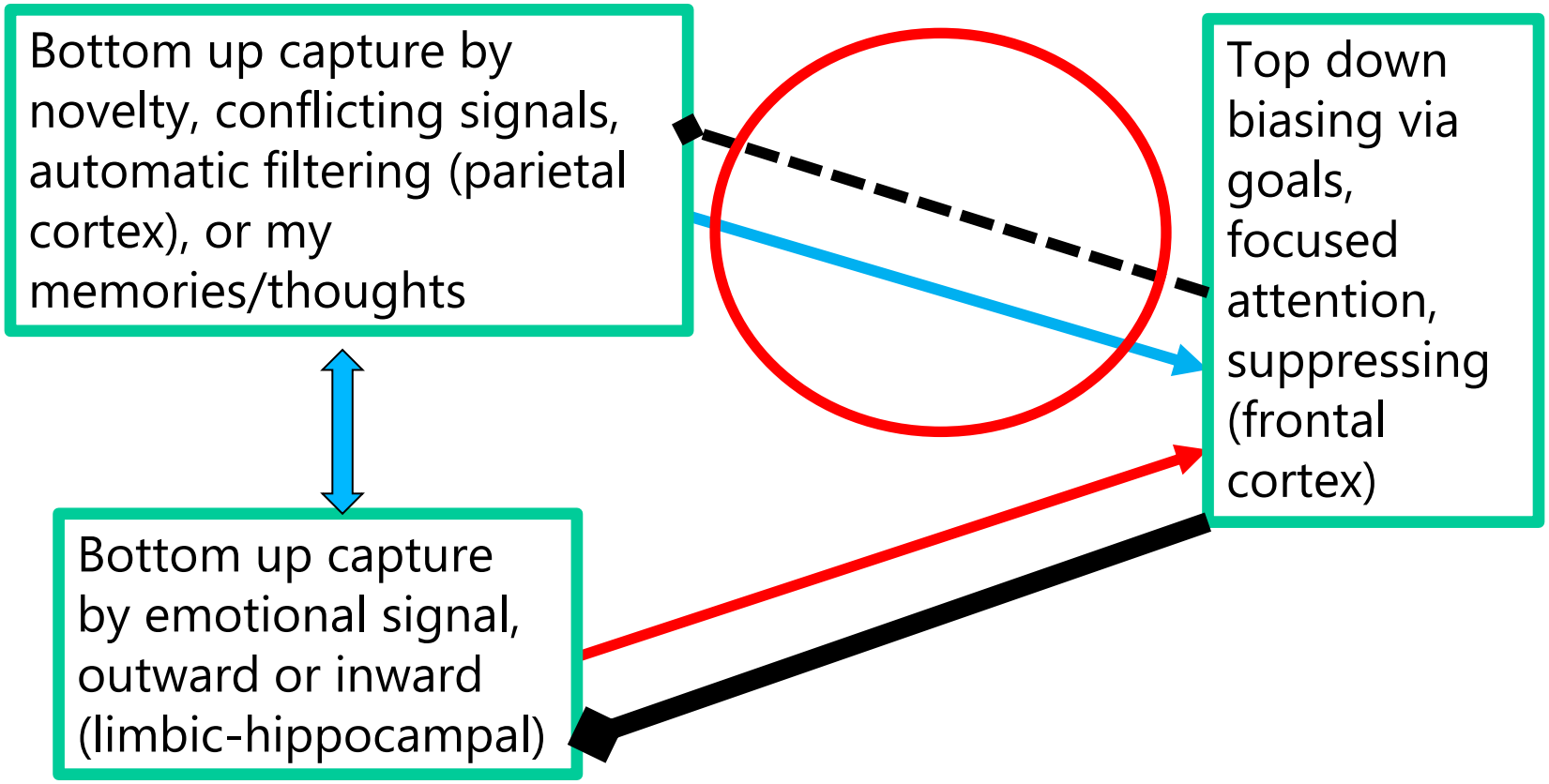


SELF-REGULATION OF ATTENTION AND BEHAVIOR IN ADHD BRAIN

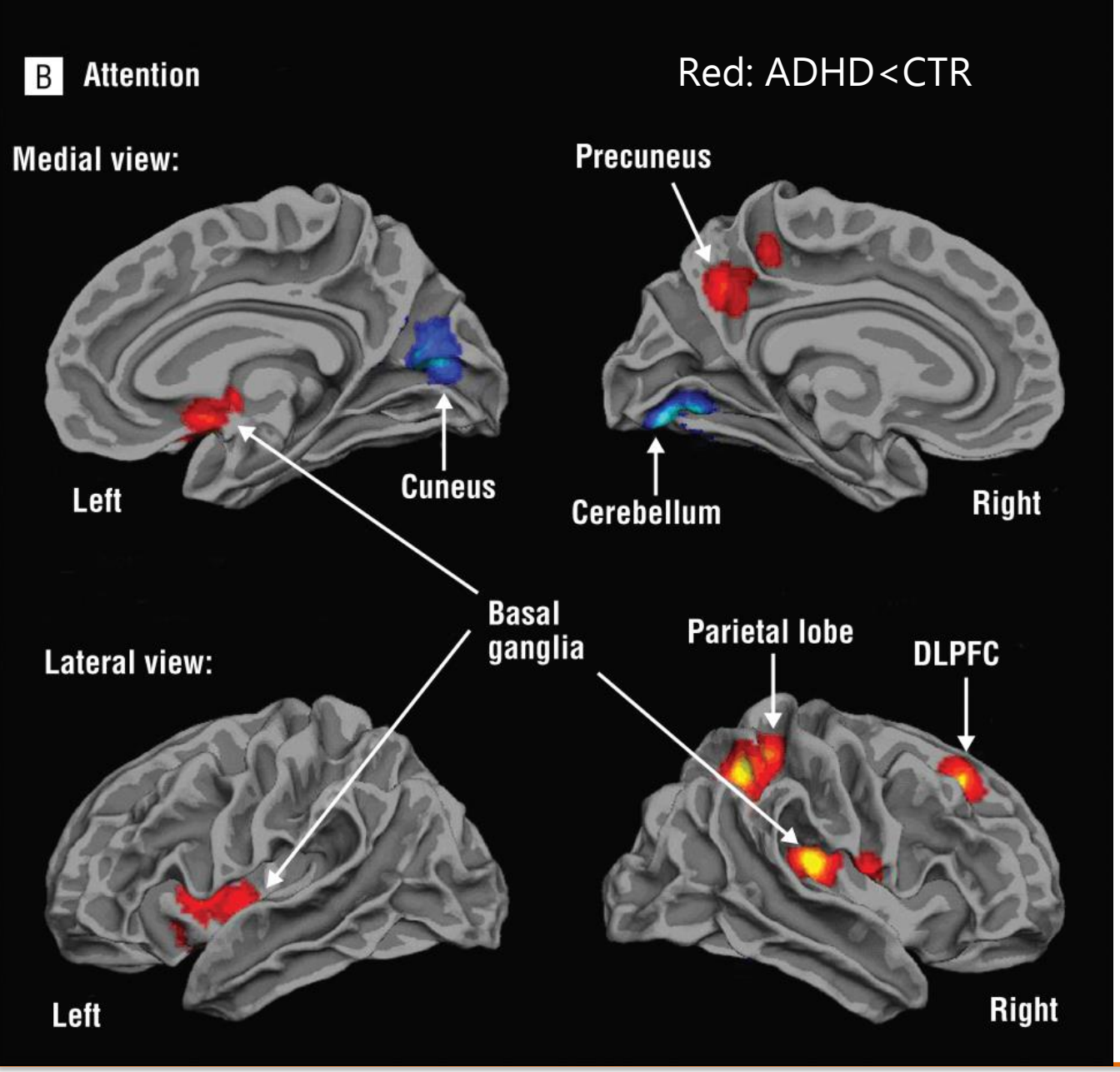
A model of attentional and behavioral self-regulation in the brain



A model of attentional and behavioral self-regulation in the brain: ADHD Model of weakened PFC-default connectivity



HOW DOES SCIENCE SUPPORT THIS MODEL IN ADHD?

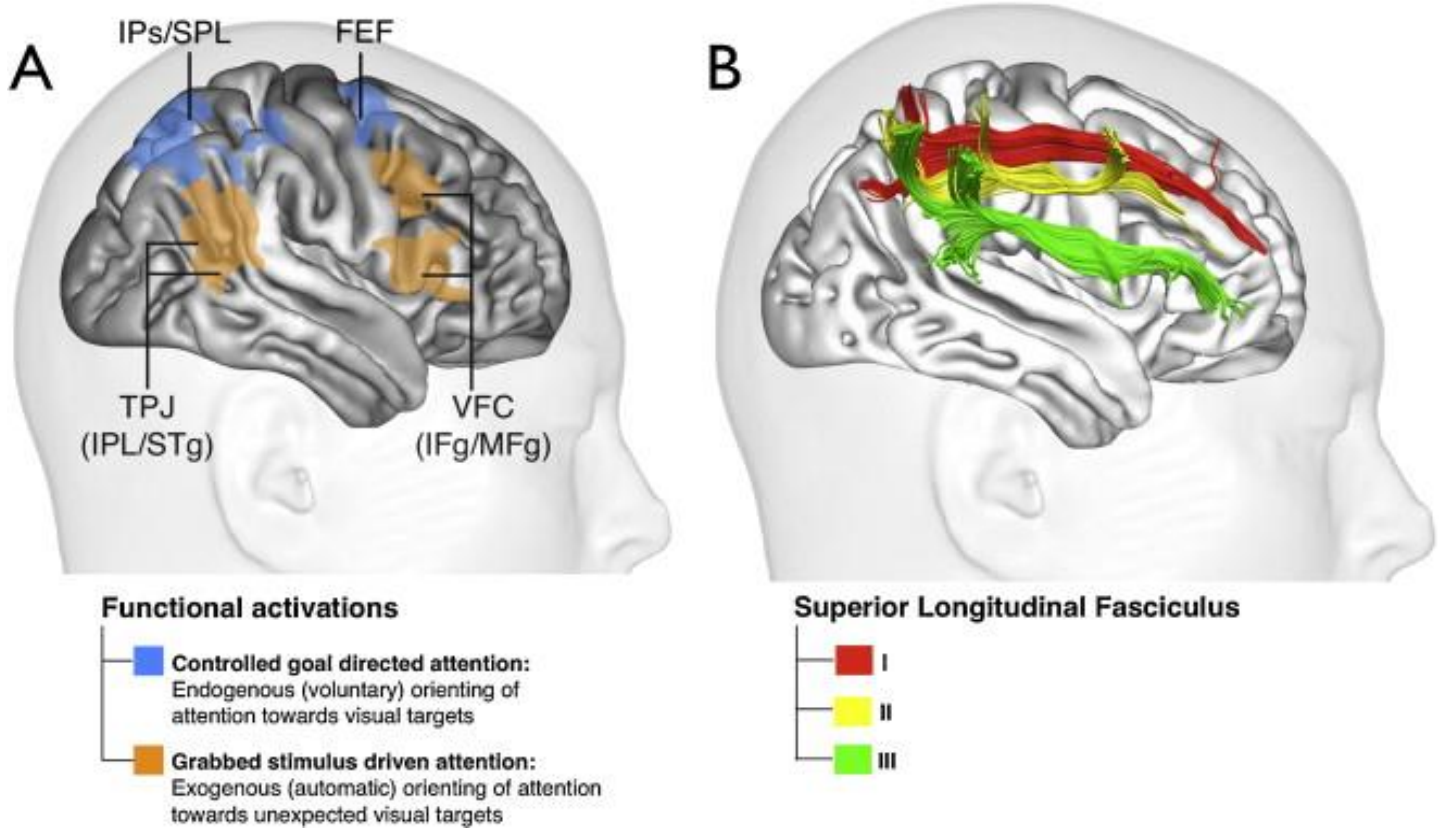


Altered **task-based activation** in components of frontal-striatal (top-bottom) brain regulation networks during attention tasks in ADHD (pooled meta-analysis results).

The JAMA Network

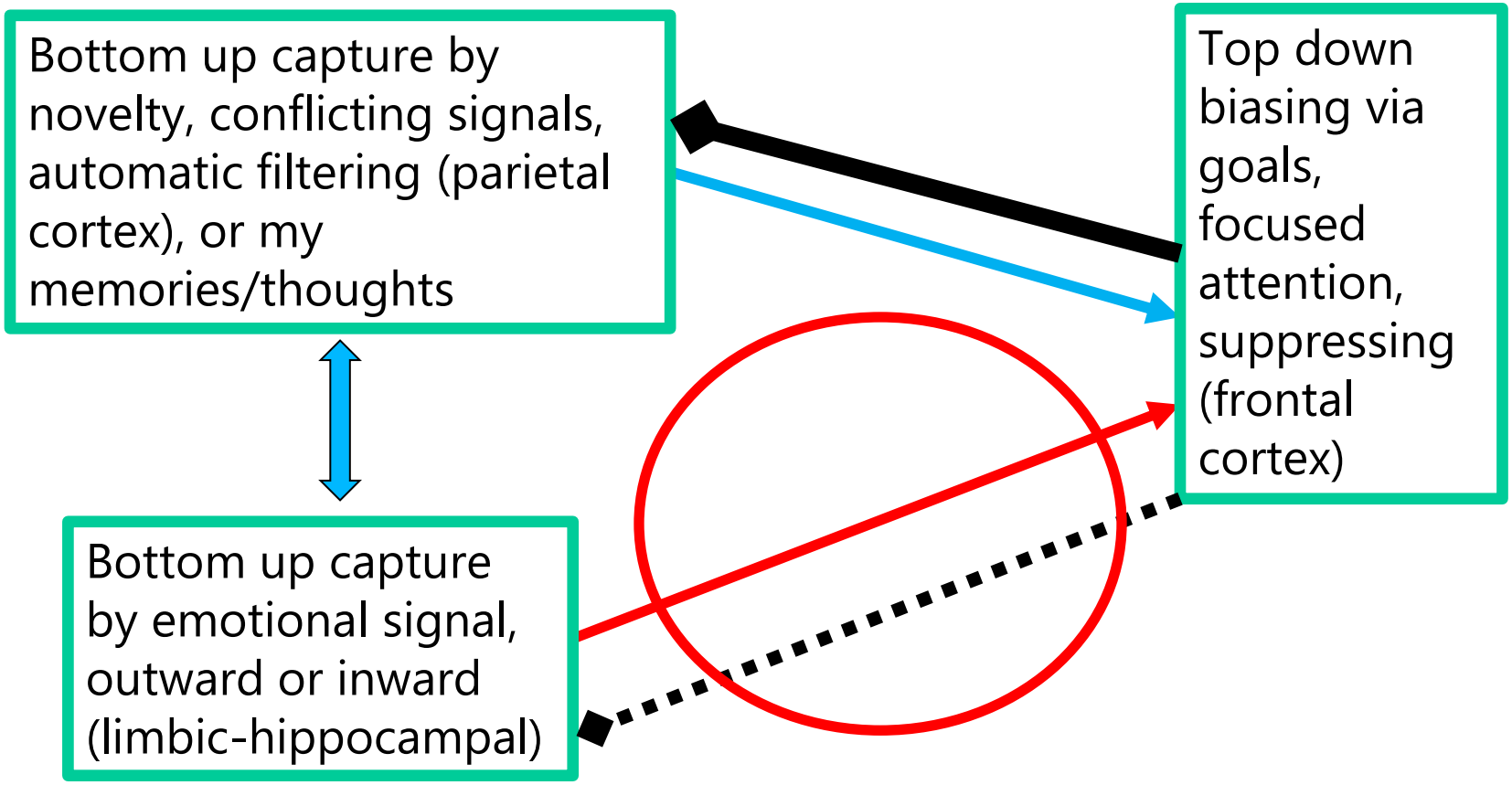
Source: Image is from Hart,Radua, et al. (2013) JAMA Psychiatry, Feb;70(2):185-98 (Fig 1). Copyright JAMA.

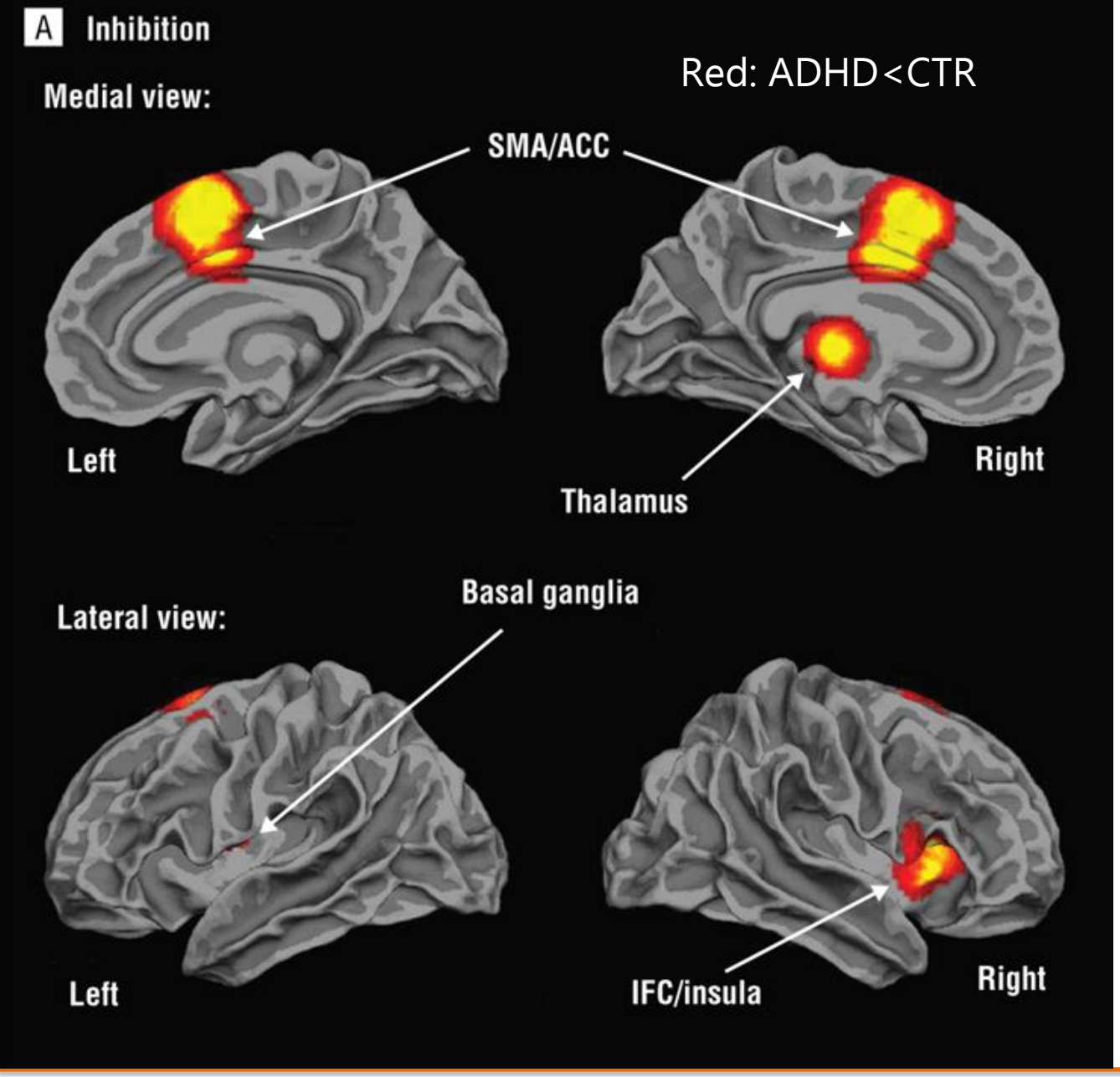
ADHD: Reduced connectivity in attention networks



(A) Right-hemisphere networks of visuospatial attention, figure adapted by Chica et al from Corbetta and Shulman (2002).
(B) The three branches of the superior longitudinal fasciculus ; adapted by Chica et al from Thiebaut et al 2011.

An alternative model of attentional and *impulsivity* self-regulation in the brain: ADHD Model of weakened ACC/insula-amygdala connectivity





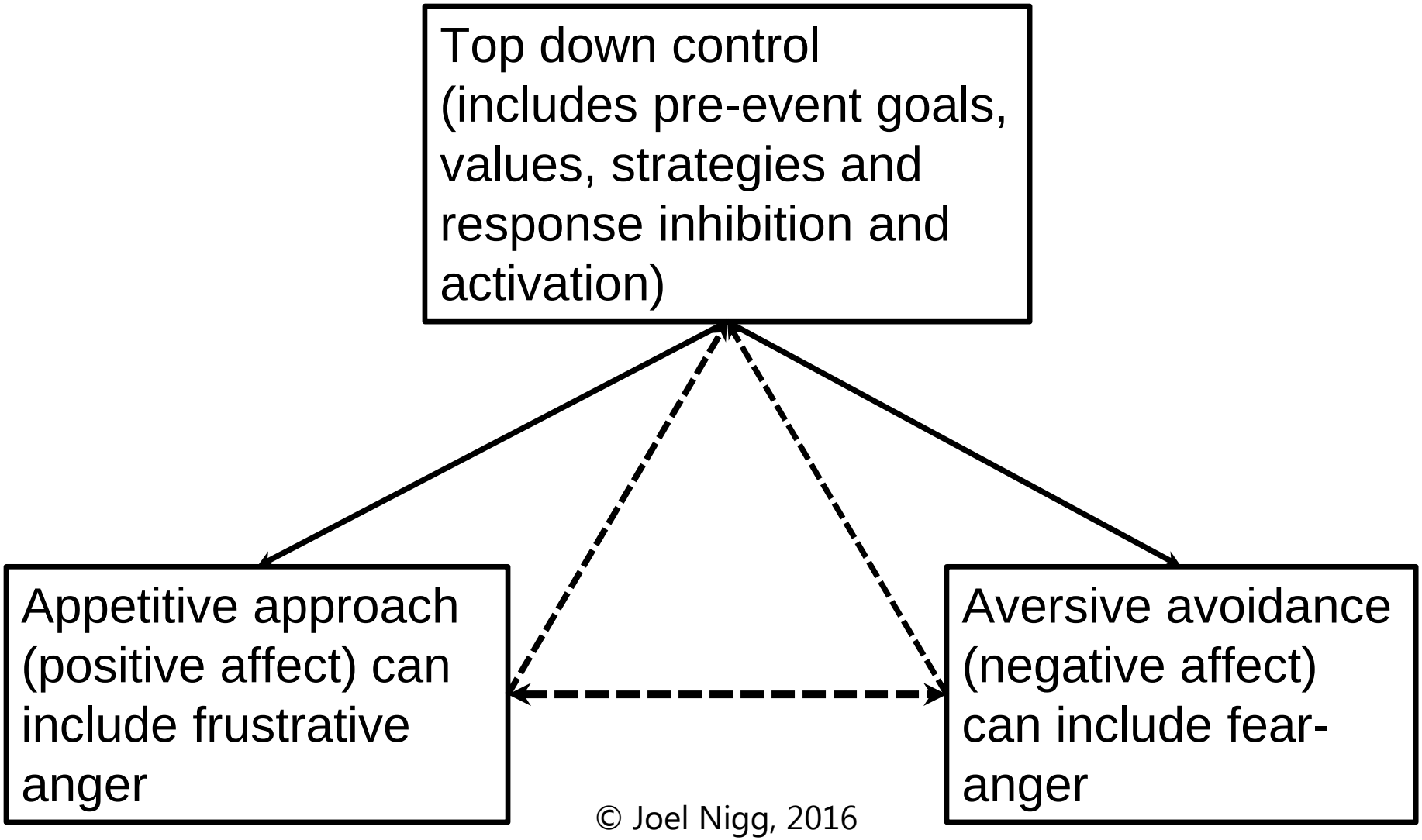
ADHD = reduced **task-based activation** in a response inhibition network during response inhibition tasks. Implies weakened top-down signaling to control impulses. (Meta-analysis results).

The JAMA Network

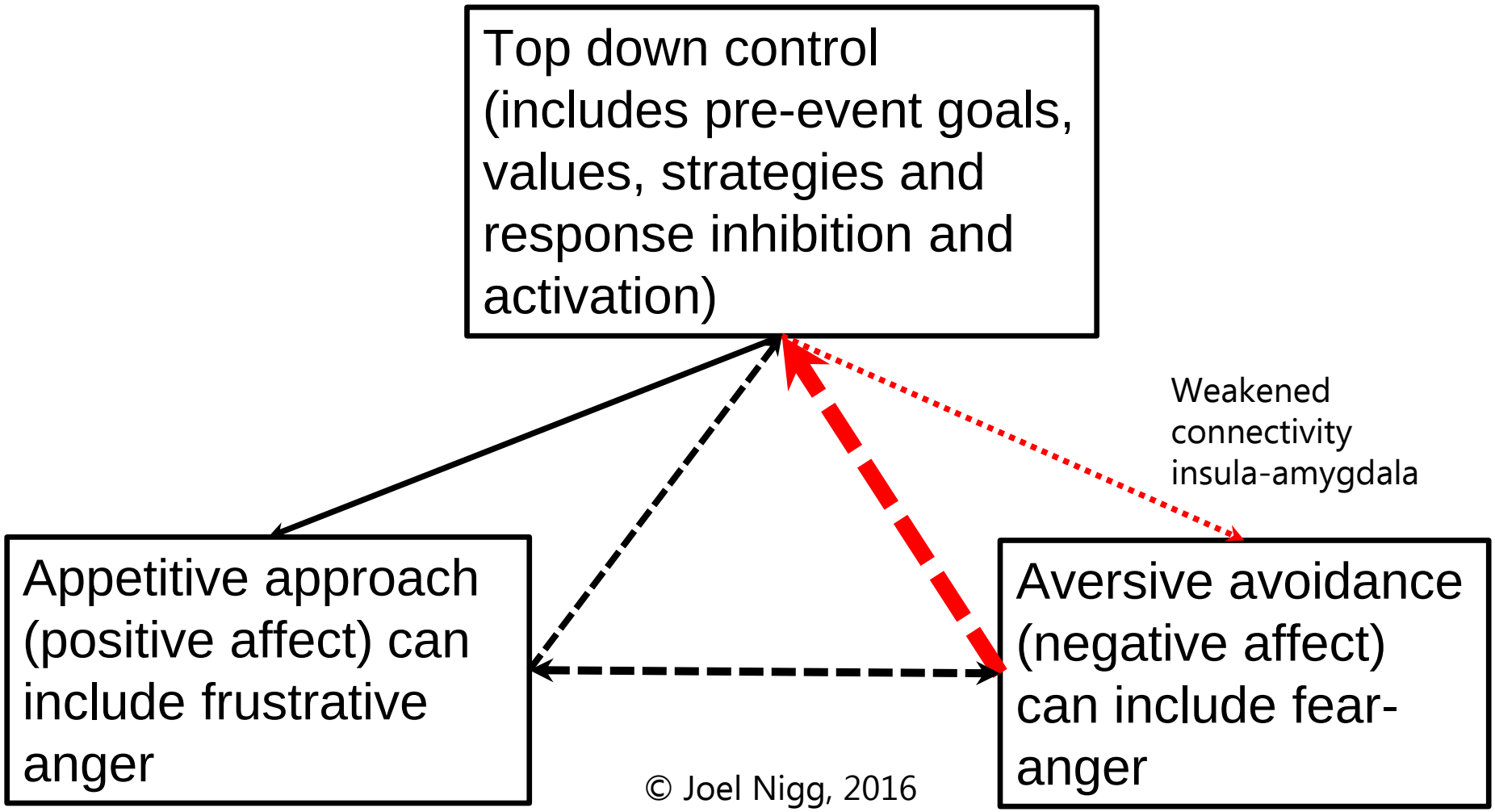
Source: Image is from Hart,Radua, et al. (2013) JAMA Psychiatry, Feb;70(2):185-98 (Fig 1). Copyright JAMA.

SELF-REGULATION OF EMOTION AND BEHAVIOR IN ADHD

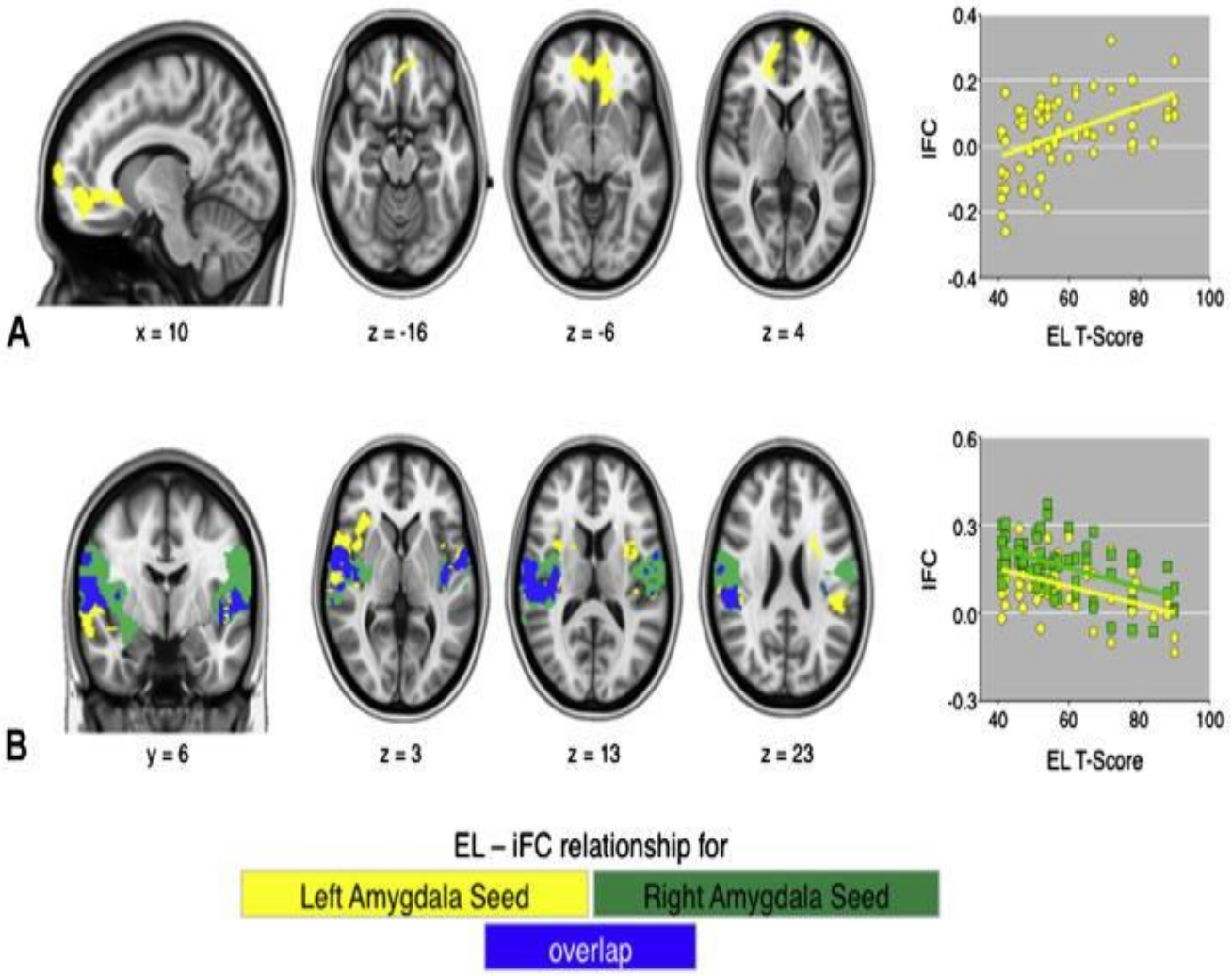
Schematic Brain Self-regulation of emotion-behavior



Schematic Brain Self-regulation of emotion-behavior- One ADHD model



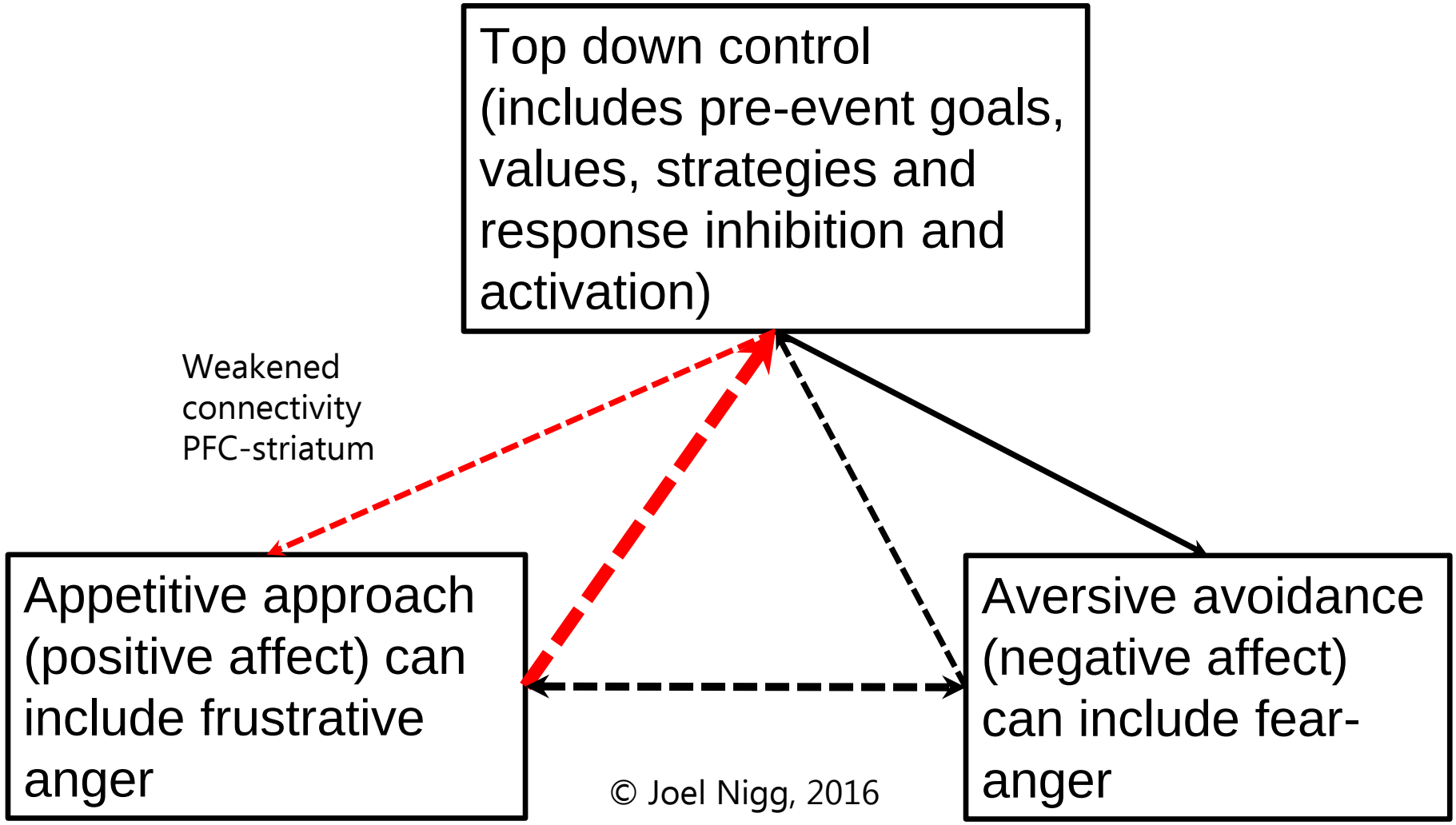
HOW DOES SCIENCE SUPPORT THIS ATTENTION EMOTION MODEL IN ADHD?

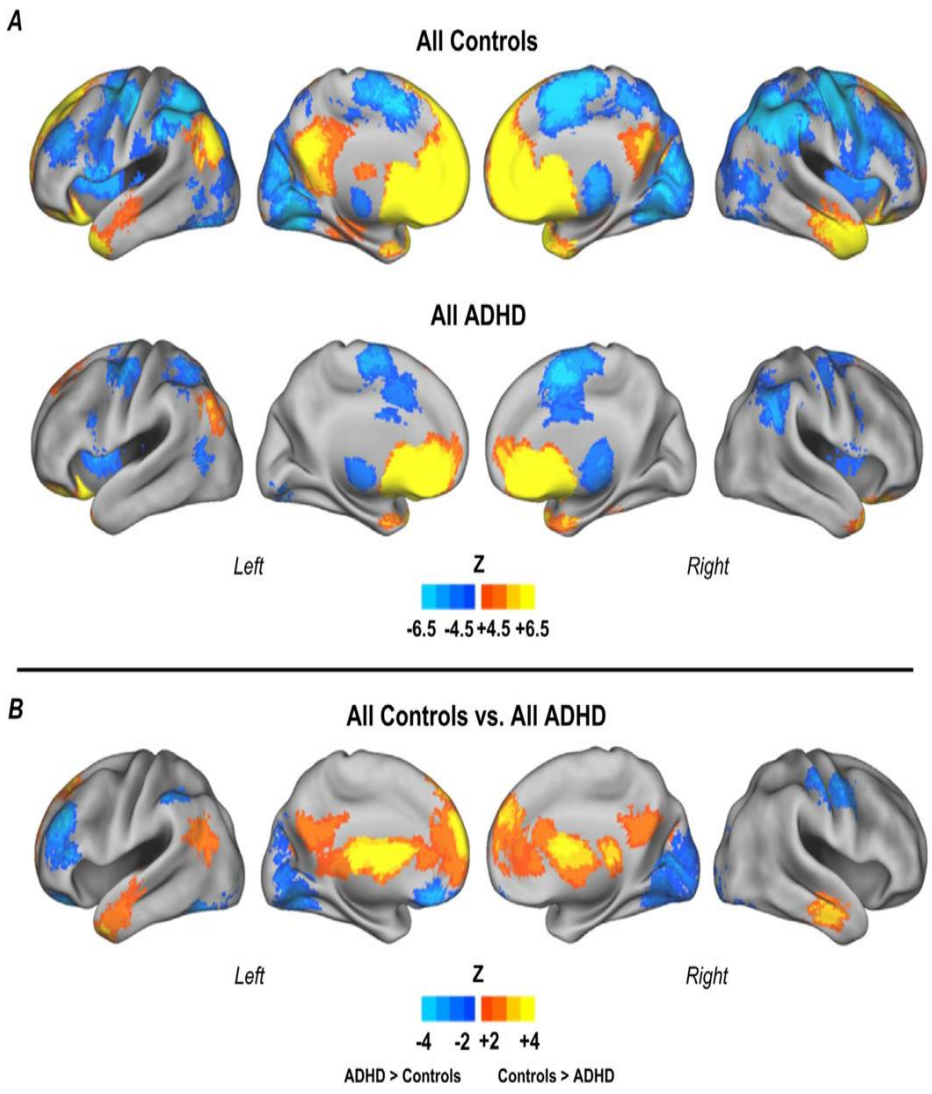


Reduced amygdal – insula **functional** connectivity associated with more emotional lability in children with ADHD(n=63)

J Am Acad Child Adolesc Psychiatry. 2014 Mar; 53(3): 351–361.e1. Published online 2013 Dec 14. doi: 10.1016/j.jaac.2013.11.012/ © American Academy Child Adolescent Psychiatry

Schematic Brain Self-regulation of emotion-behavior-A second ADHD model



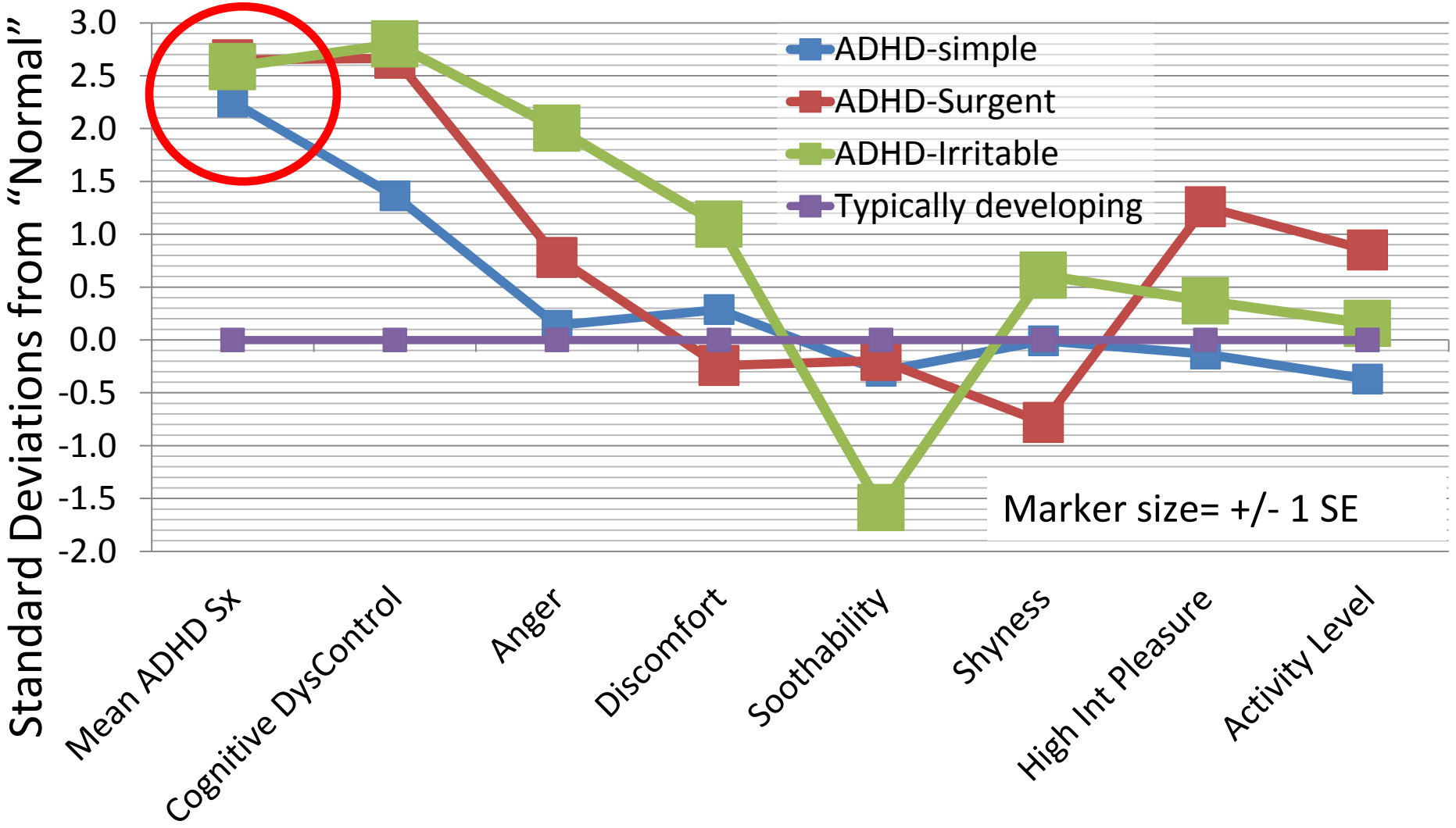


Altered development of reward circuits in ADHD associated with impulsive reward seeking (n=106). Figure shows reduced **functional** connectivity of nucleus accumbens to key regions of prefrontal cortex and other regions in ADHD

Costa Dias TG, Iyer SP, Carpenter SD, Cary RP, Wilson VB, Mitchell SH, Nigg JT, Fair DA. Dev Cogn Neurosci. 2015 Feb;11:155-74. doi: 10.1016/j.dcn.2014.12.005.

BUT KIDS WITH ADHD ARE NOT ALL THE SAME…

Detailed look at subtypes of ADHD based on temperament (emotional regulation)(n=500: 310 ADHD, 190 control)



Updated and adapted from Karalunas et al, JAMA Psychiatry 2014 © JAMA network);
This figure © Joel Nigg

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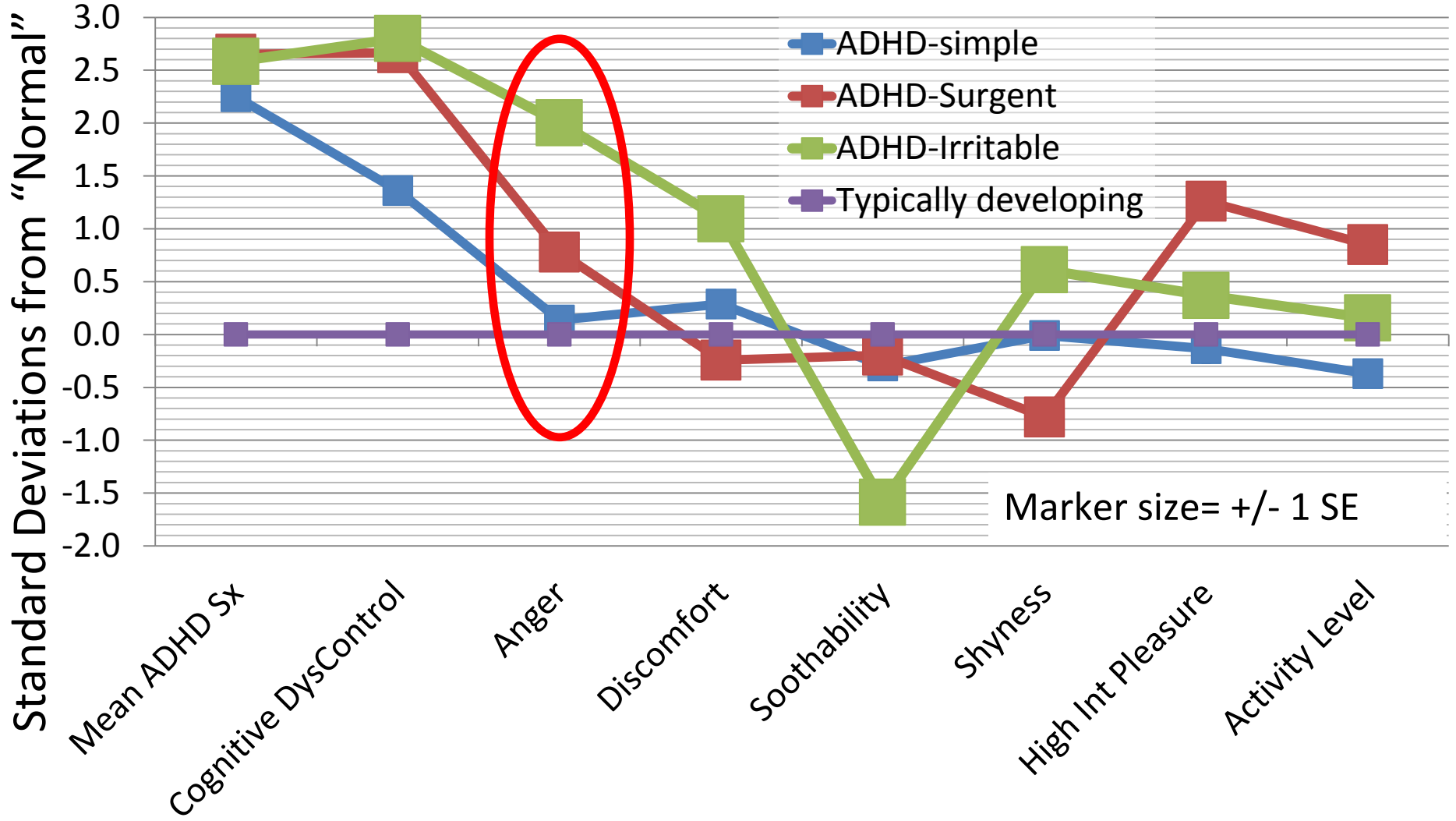

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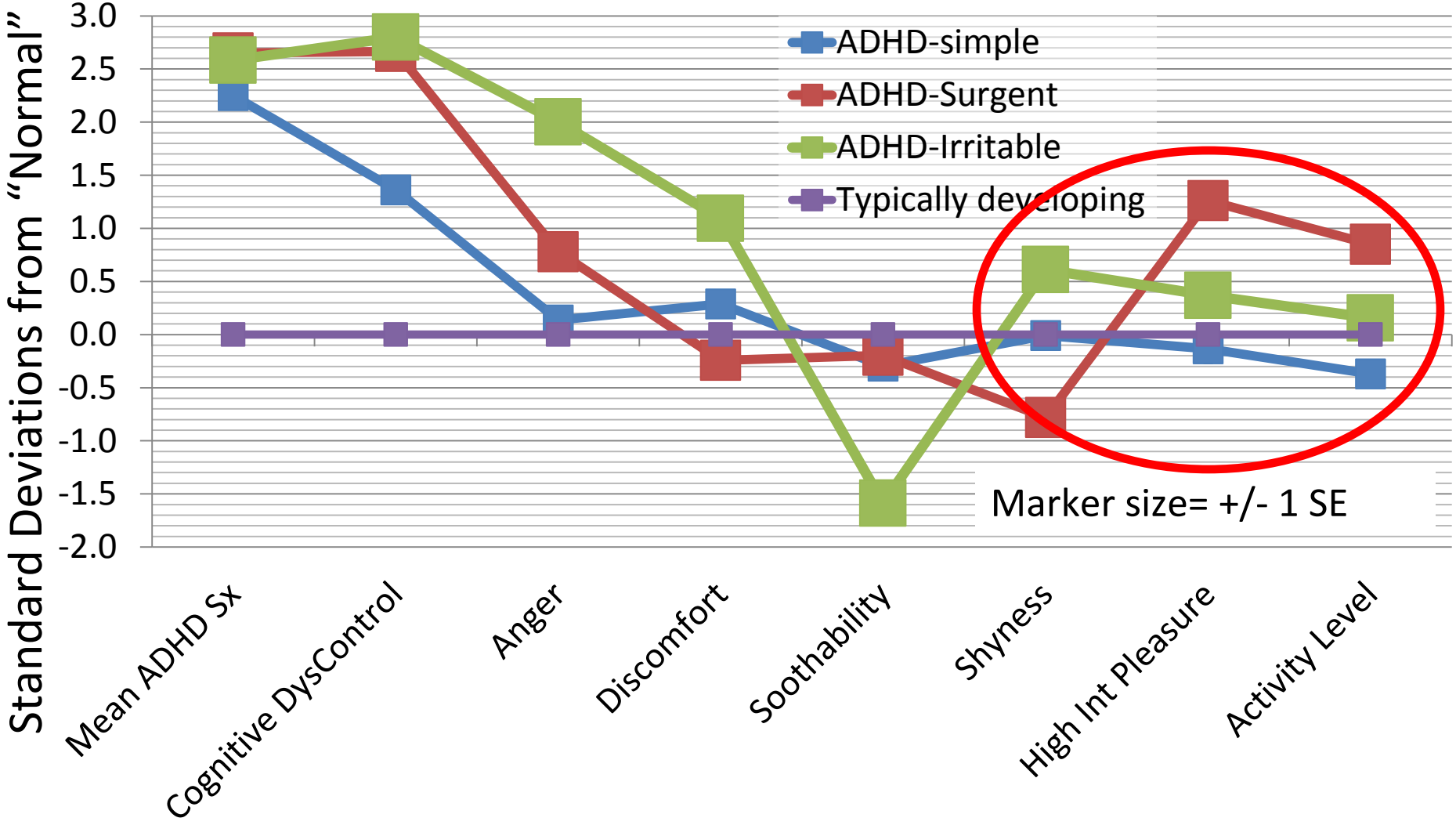
Detailed look at subtypes of ADHD based on temperament (emotional regulation)(n=500: 310 ADHD, 190 control)



Updated and adapted from Karalunas et al, JAMA Psychiatry 2014 © JAMA network);
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Summary: ADHD and Brain

- ADHD reflects under-developed connections in brain networks
- These networks handle self-regulation of attention, arousal, and emotion
- Key networks involve
  - Prefrontal cortex-parietal circuits (attention/arousal)
  - Prefrontal-subcortical circuits (emotion/behavior)
  - Dopamine, norepinephrine, glutamate, and other brain chemicals
  - Structural (white matter) and functional connections
- Children with ADHD appear to exhibit different profiles of emotional regulation and attention problems, perhaps associated with different patterns of maturation of brain networks

Thank You

ADHD: The Brain-Behavior Connection

Joel Nigg, Ph.D

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Please enter your questions in the box to your right.

Please note: Attendance and all questions are confidential. None of today's webinar attendees can see the names of other attendees nor can they see the questions being submitted. Only the moderator of the webinar will see your questions.

ADDitude does not provide medical advice, diagnosis, or treatment. The material in this webinar is provided for educational purposes only.

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Upcoming Webinars

- **Thursday, July 7th at 12pm ET**
  What Summer Slide? Parent Strategies for Year-Round Learning with Ann Dolin, M.Ed.
- **Thursday, July 14th at 1pm ET**
  How to Start (and End) the School Year Organized with Susan Lasky, M.A.

Visit www.additudemag.com/webinars for announcements of ADDitude's upcoming webinars.

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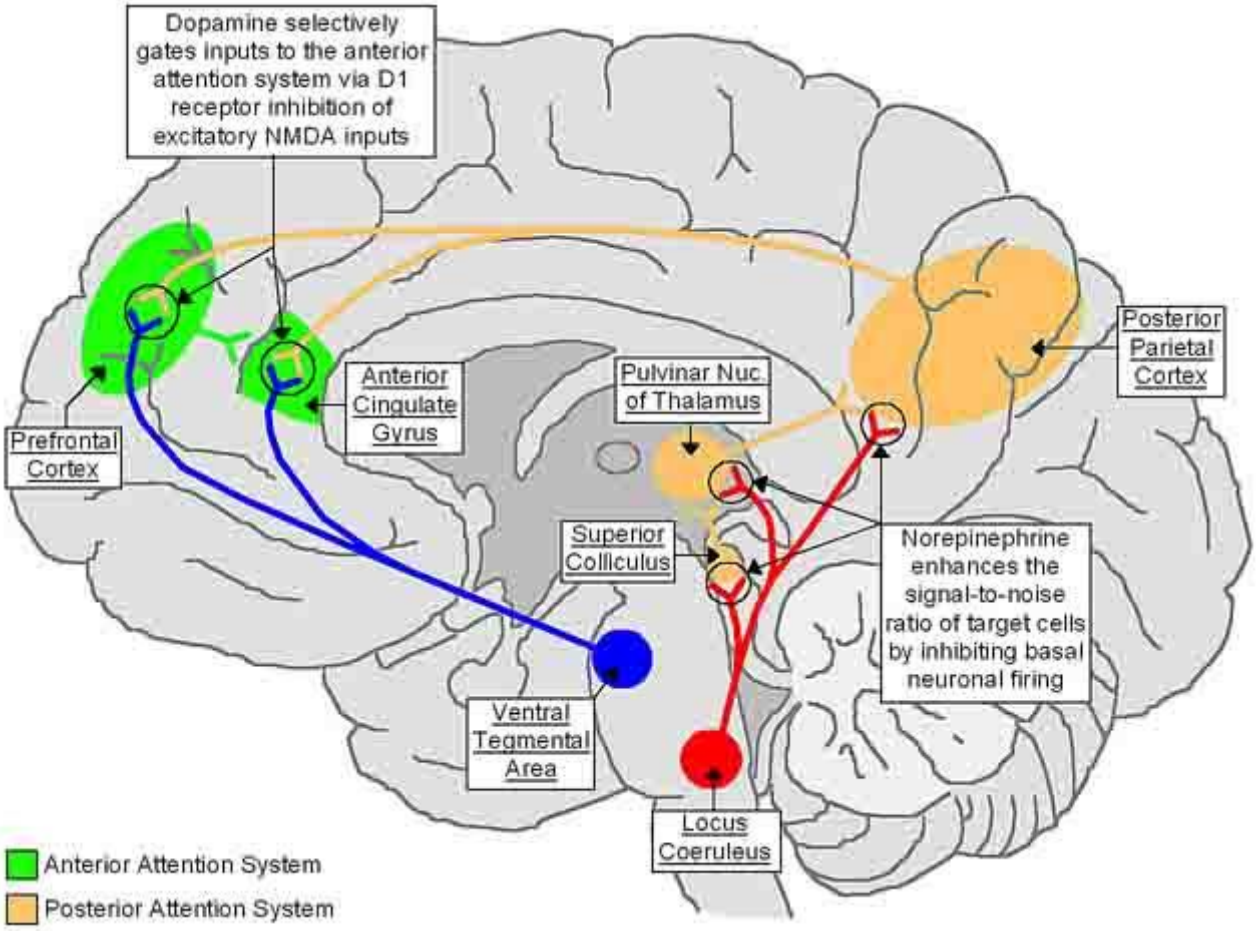
Thank You!

If you missed any part of today's webinar, a recording is available for replay at www.additudemag.com/webinars.

To continue the conversation, we invite you to join us on

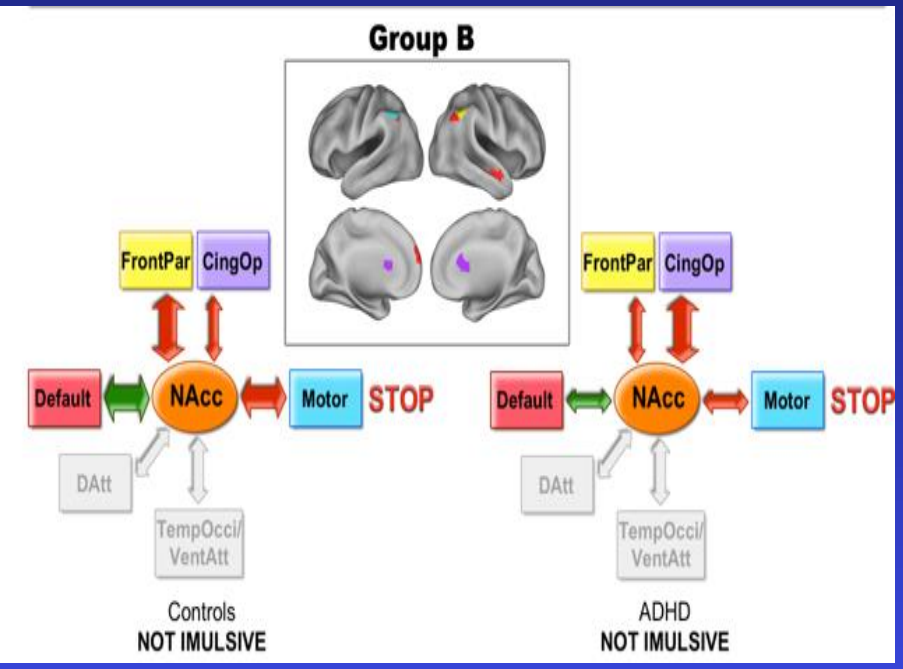
ADDConnect

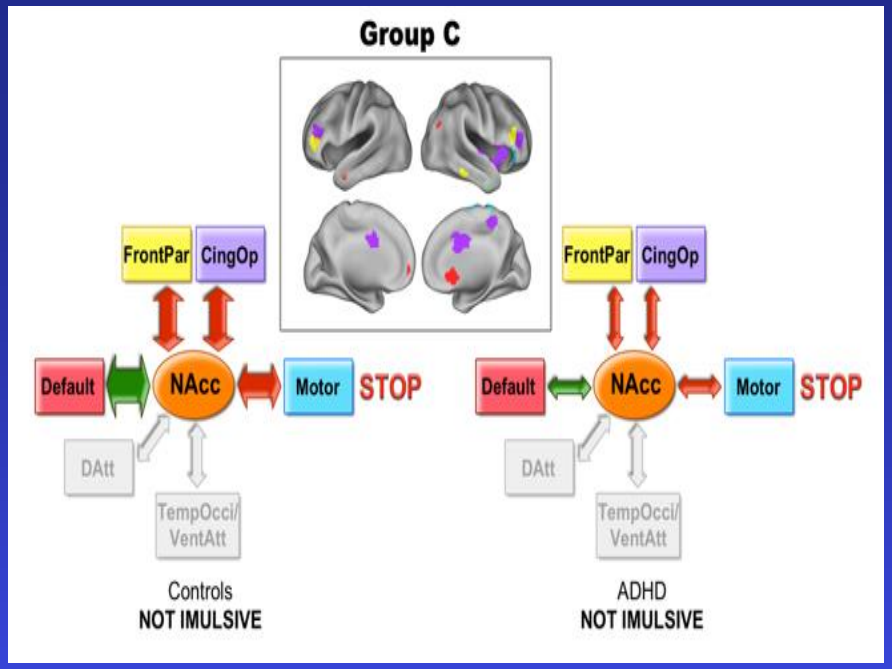
ADDitude's online community for attention deficit support and solutions where you can join our ongoing ADHD discussion groups:
www.addconnect.com.

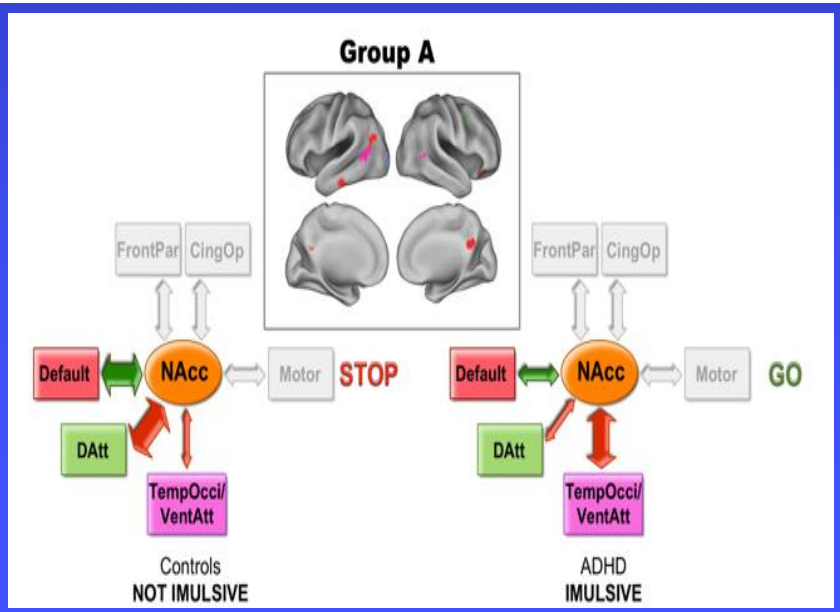


Neurotransmitter function view of ADHD problems in arousal and attentional control

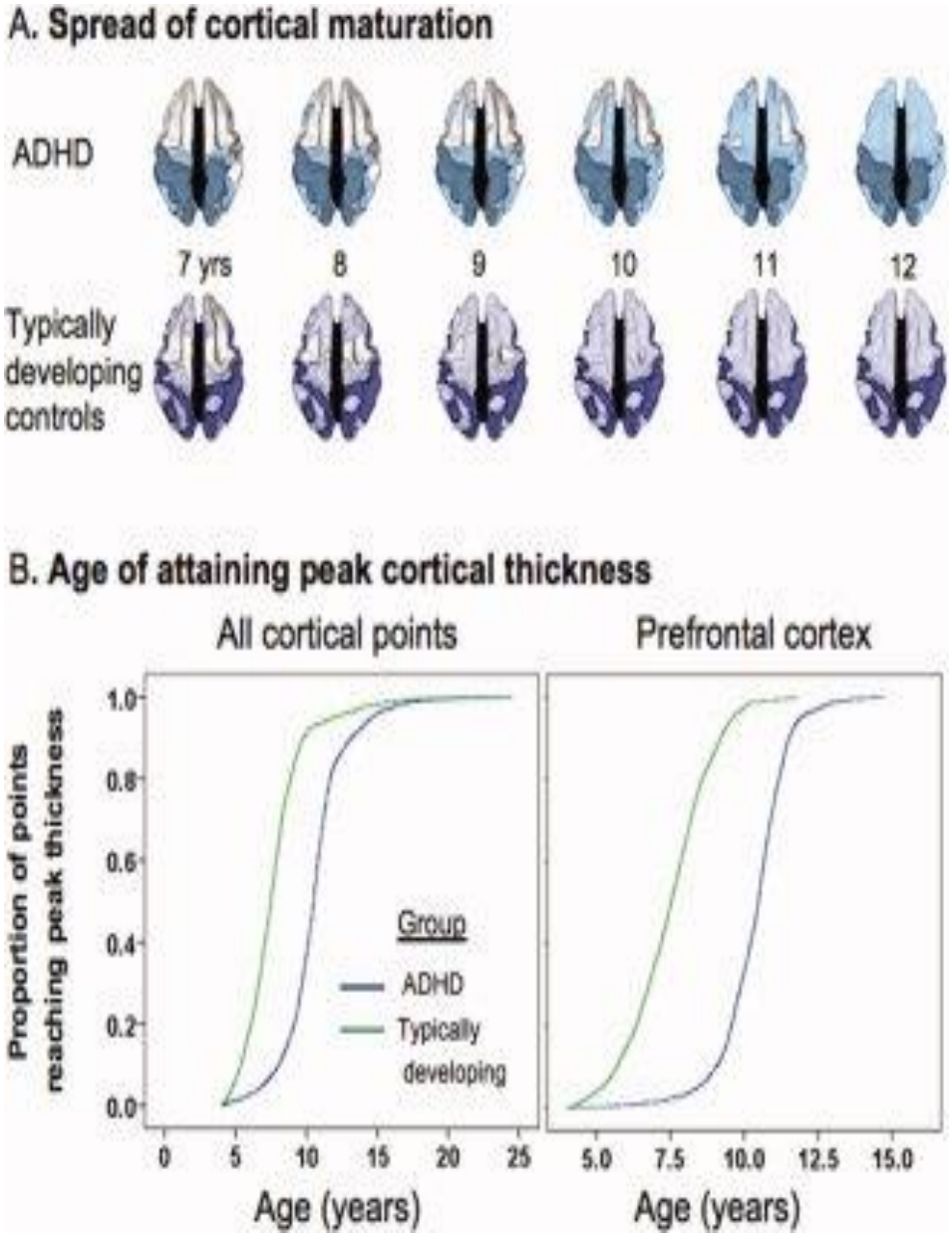
Subgroups of ADHD within reward circuits (n=106)





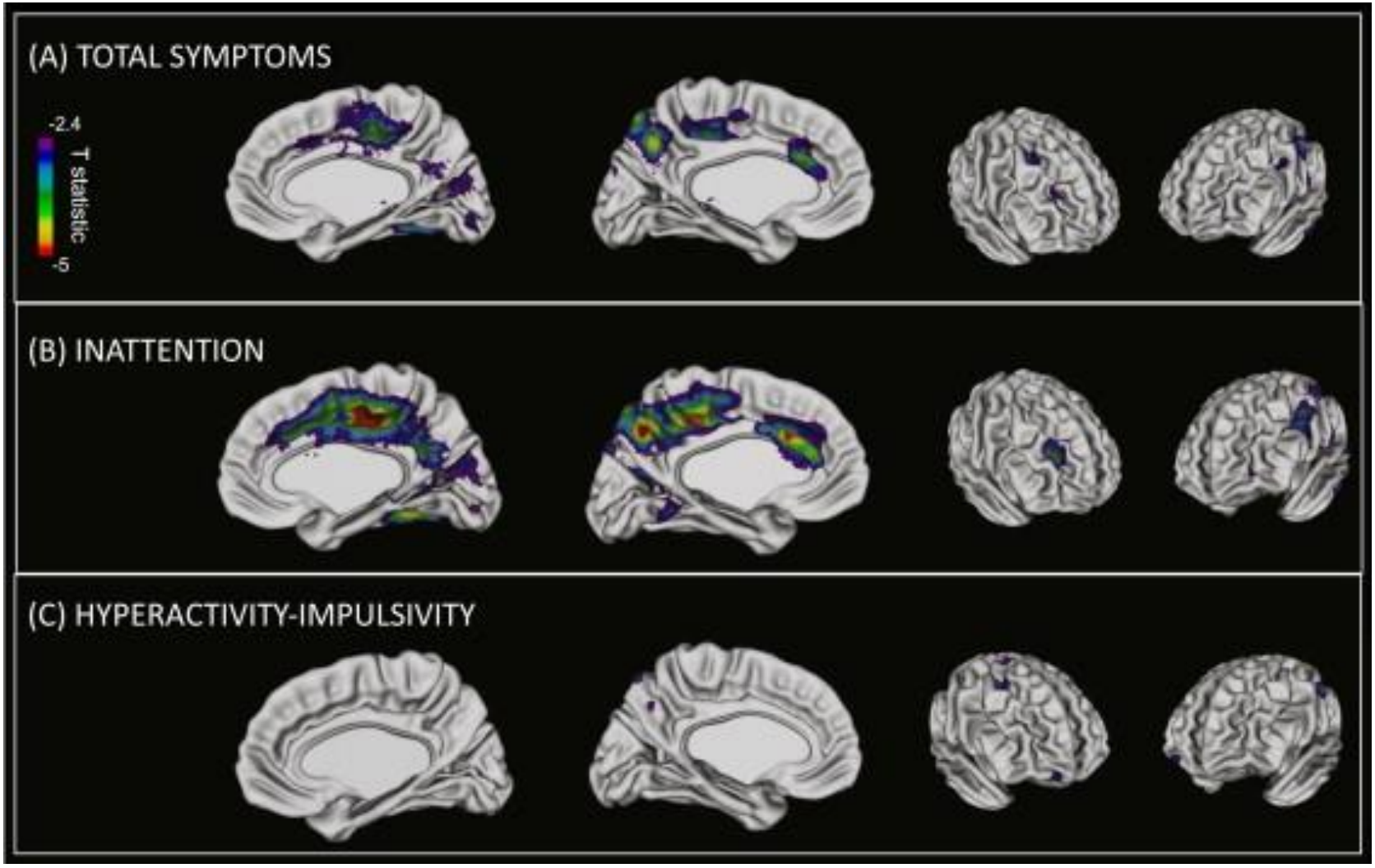


Costa Dias TG, Iyer SP, Carpenter SD, Cary RP, Wilson VB, Mitchell SH**, Nigg** JT, Fair DA. Dev Cogn Neurosci. 2015 Feb;11:155-74. doi: 10.1016/j.dcn.2014.12.005.

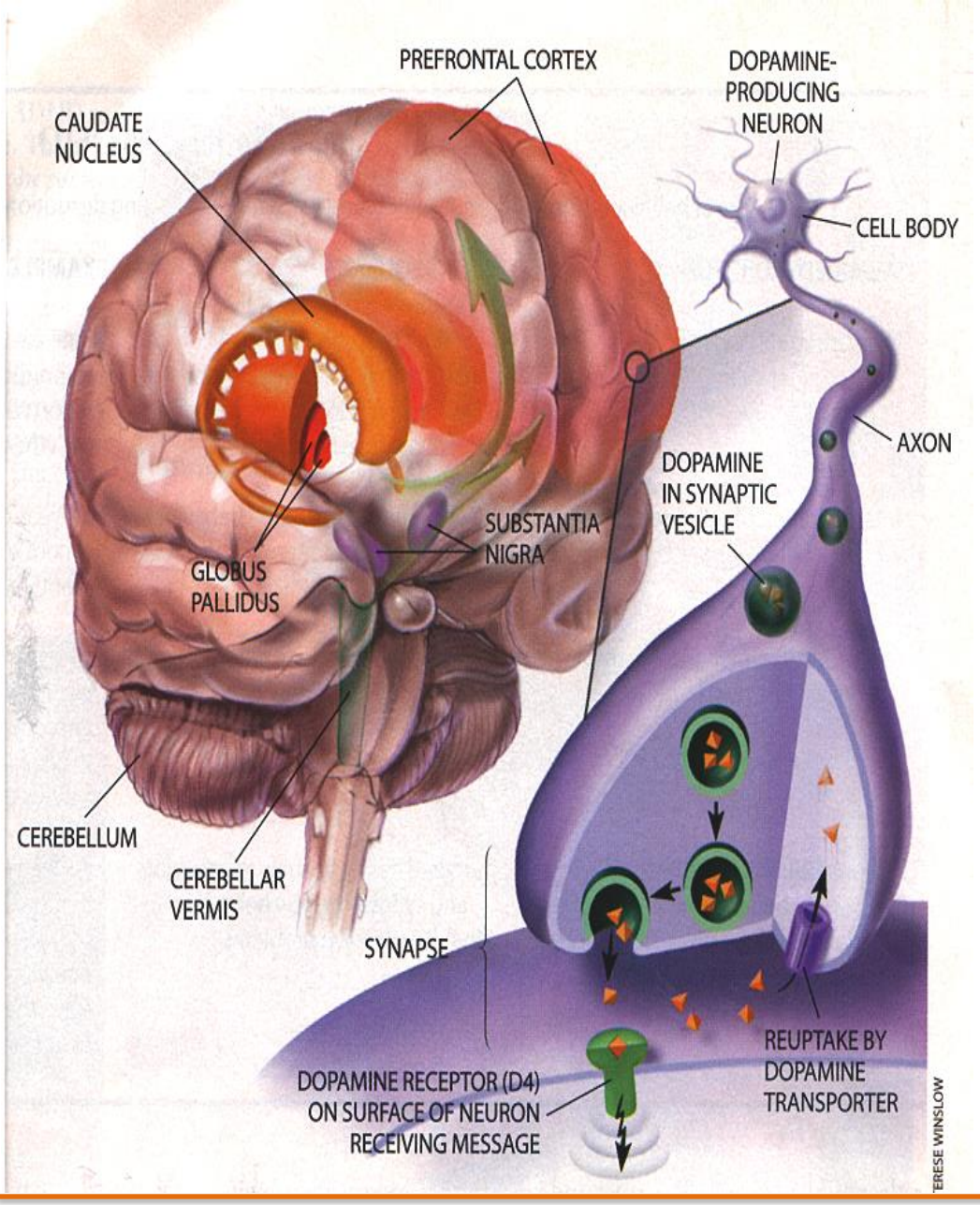


Slower maturation of cortical thickness in ADHD by about 2-3 years

Shaw et al; Proceedings of the National Academies of Science, 2007 Dec 4;104(49):19649-54.
© PNAS



From Shaw, Malek, et al (2013). Trajectories of Cerebral Cortical Development in Childhood and Adolescence and Adult Attention-Deficit/Hyperactivity Disorder Biological Psychiatry, Volume 74, Issue 8, 2013, 599 – 606 A) Regions where the total number of attention-deficit/hyperactivity disorder symptoms in adulthood are significantly associated ($p < .05$, adjusted for multiple comparisons) with the cortical trajectories from childhood into adulthood. The association is stronger for inattentive (B) than hyperactive-impulsive symptoms (C). © Society for Biological Psychiatry



The Classic Understanding of ADHD Neural Involvement

Insufficient synaptic DA reduces salience and significance of signals

Graphic is copyright Scientific American; Sept. 1998, p. 47

Graph of Community organization analysis showing different groups based on connectivity to the nucleus accumbens reward-related circuits in ADHD

Costa-Dias et al (2015) Dev Cogn Neurosci. Author manuscript; available in PMC 2016 Feb 1.Published in final edited form as:
Dev Cogn Neurosci. 2015 Feb; 11: 155–174.