Neurologie du TDAH

- Deux modèles qui s'opposent
  - modèle classique : TDAH = défaut d'inhibition de l'action (Barkley)
    - Ref : systèmes de contrôle exécutif : "cool" executive
  - Modèle plus récent : TDAH = défaut de capacité à différer la récompense (delay aversion = "hot executive")
    - Ref : modèle des circuits de la récompense
    - Cf. comorbidité troubles des conduites (CD) ~ 50%

I/ Le modèle classique

= inhibition de l'action (Baddeley)

Imagerie fonctionnelle dans des protocoles d'inhibition (go-no-go, stop signal, flanker, Stroop….)

→ Hypofonctionnement du cortex frontal

ADVANCING THE NEUROSCIENCE OF ADHD

Structural Brain Imaging of Attention-Deficit/ Hyperactivity Disorder

Larry J. Seidman, Eve M. Valera, and Nikos Mal

ELSEVIER
SAUNDERS

Psychiatr Clin N Am
27 (2004) 323–347

Brain function and structure attention-deficit/hyperactiv

Larry J. Seidman, PhD[a–f,*], Eve M.
George Bush, MD, M

Neuropsychopharmacology REVIEWS (2010) 35, 27
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◆ Human Brain Mapping 31:904–916 (2010) ◆

Is the ADHD Brain Wired Differently? A Review on Structural and Functional Connectivity in Attention Deficit Hyperactivity Disorder

Kerstin Konrad,[1,2,3]* and Simon B. Eickhoff[2,3,4]

[1]*Child Neuropsychology Section, Department of Child and Adolescent Psychiatry and Psychotherapy, University Hospital of the RWTH Aachen, Germany*
[2]*Institute of Neuroscience and Medicine (INM-2, INM-3), Research Center Juelich, Germany*
[3]*JARA – Translational Brain Medicine, Germany*
[4]*Department of Psychiatry and Psychotherapy, University Hospital of the RWTH Aachen University, Germany*

Attention-Deficit/Hyperactivity Disorder and Attention Networks

George Bush*,[1,2,3,4]

Eur Arch Psychiatry Clin Neurosci (2006) 256 [Suppl 1]:I/32–I/41

Marc Schneider · Wolfgang Retz · Andrew Coogan · Johannes Thome · Michael Rösler

Anatomical and functional brain imaging in adult attention-deficit/hyperactivity disorder (ADHD) – A neurological view

MENTAL RETARDATION AND DEVELOPMENTAL DISABILITIES
RESEARCH REVIEWS *9: 184–195 (2003)*

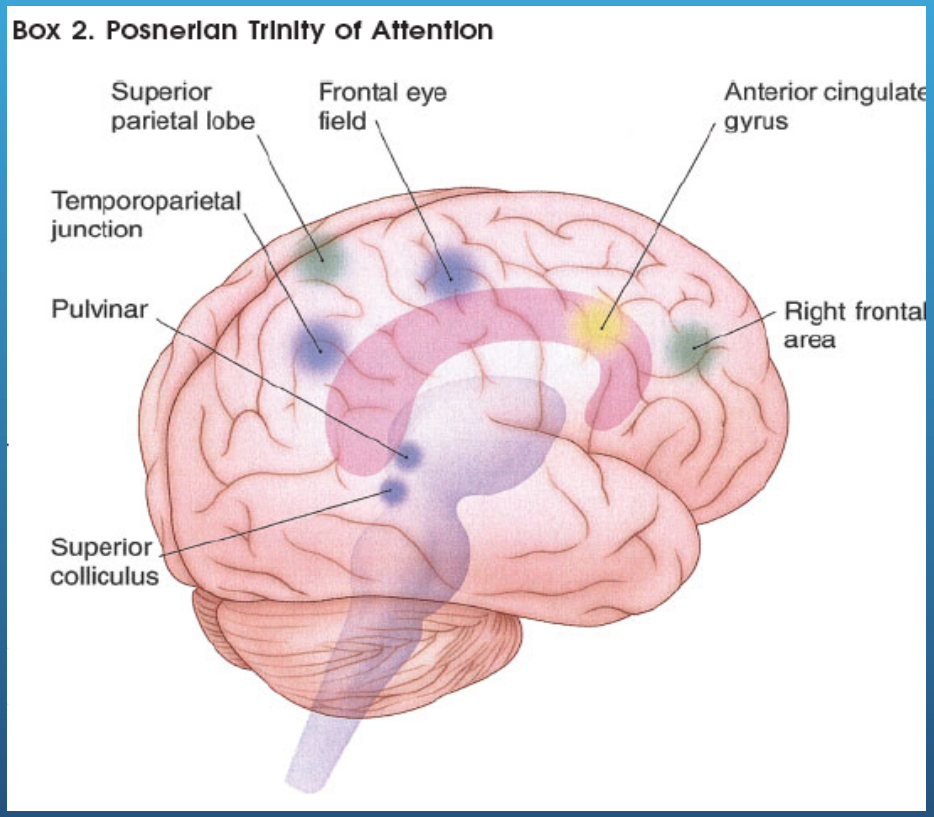
A Review of the Biological Bases of ADHD: What Have We Learned From Imaging Studies?

Sarah Durston*

Department of Child and Adolescent Psychiatry, University Medical Center Utrecht, the Netherlands and Sackler Institute for Developmental Psychobiology, Weill Medical College of Cornell University, New York, New York

Substrat cérébral du trouble attentionnel

- Travaux de Posner et coll.



Le triple système de l'attention selon Posner : alerte, orientation, contrôle exécutif

orienting

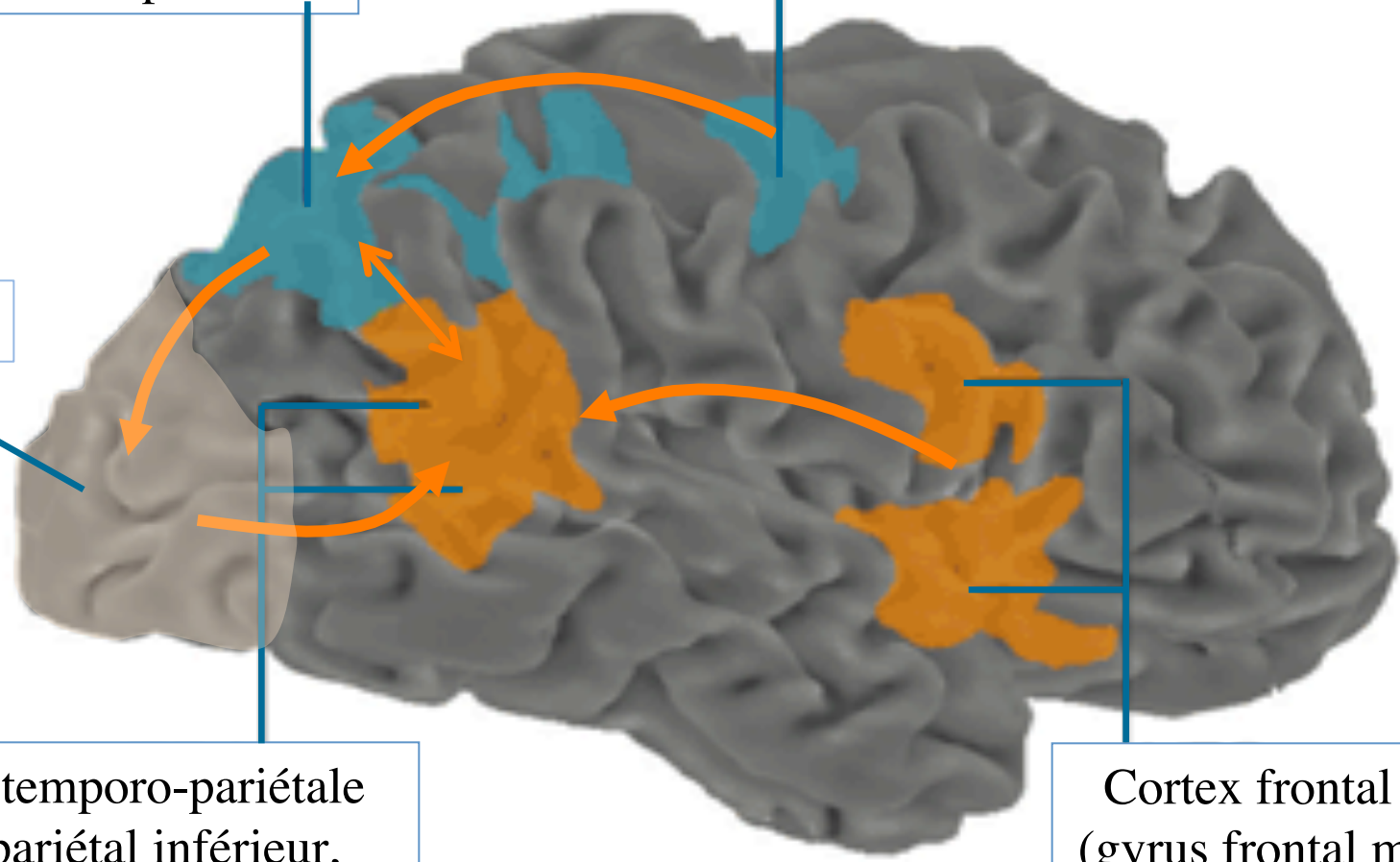
alerting

Executive (conflict)

Réseau fronto-pariétal dorsal (bilatéral) : attention endogène; génération d'un « set attentionnel » applicable lors du traitement du stimulus dans une tâche donnée

Sillon intra-pariétal/
Lobule pariétal supérieur

Frontal Eye Field



Cortex visuel

Jonction temporo-pariétale
(lobule pariétal inférieur,
gyrus temporal supérieur

Cortex frontal ventral
(gyrus frontal moyen et
inférieur)

Corbetta et al., 2002

Réseau fronto-pariétal ventral (fortement latéralisé à droite) : attention exogène; détection de stimuli comportementalement pertinents. Système d'alerte pour le système dorsal.

Neuropsychopharmacology REVIEWS (2010) 35, 278–300
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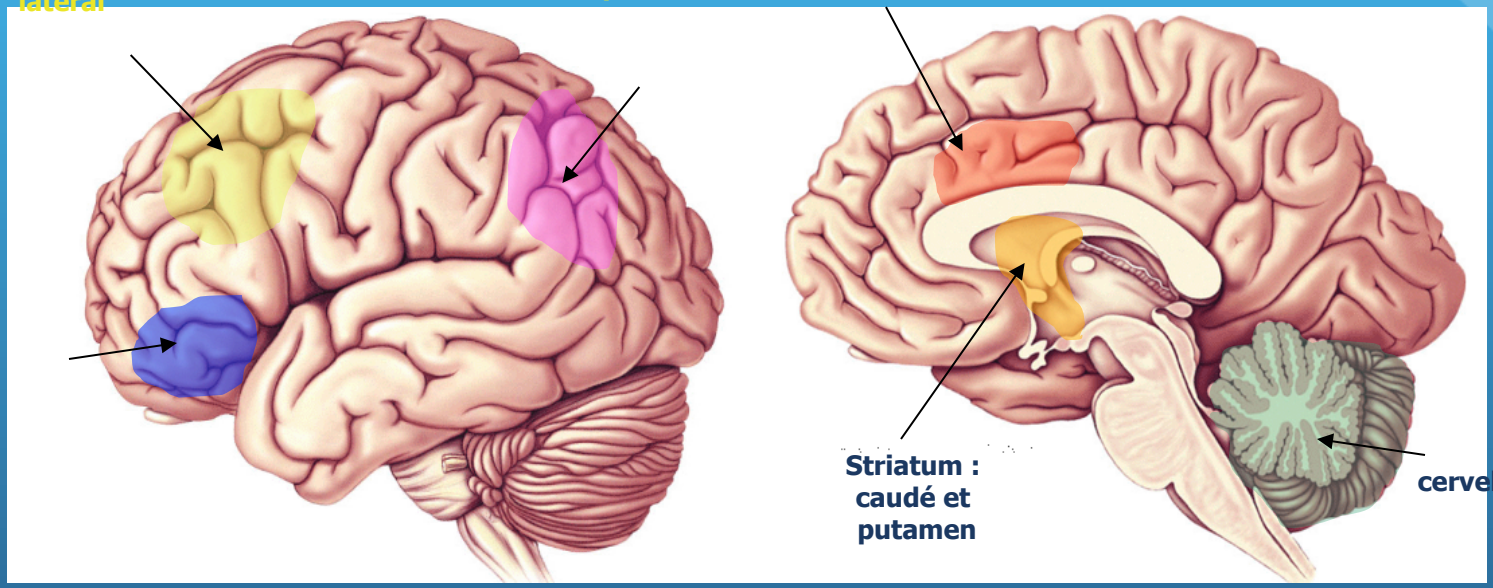
www.neuropsychopharmacology.org

REVIEW

Attention-Deficit/Hyperactivity Disorder and Attention Networks

George Bush*,1,2,3,4



Les principales régions cérébrales dysfonctionnelles dans le TDAH (méta-analyse)

BIOL PSYCHIATRY
1999;45:1542–1552

Anterior Cingulate Cortex Dysfunction in Attention-Deficit/Hyperactivity Disorder Revealed by fMRI and the Counting Stroop

George Bush, Jean A. Frazier, Scott L. Rauch, Larry J. Seidman, Paul J. Whalen, Michael A. Jenike, Bruce R. Rosen, and Joseph Biederman

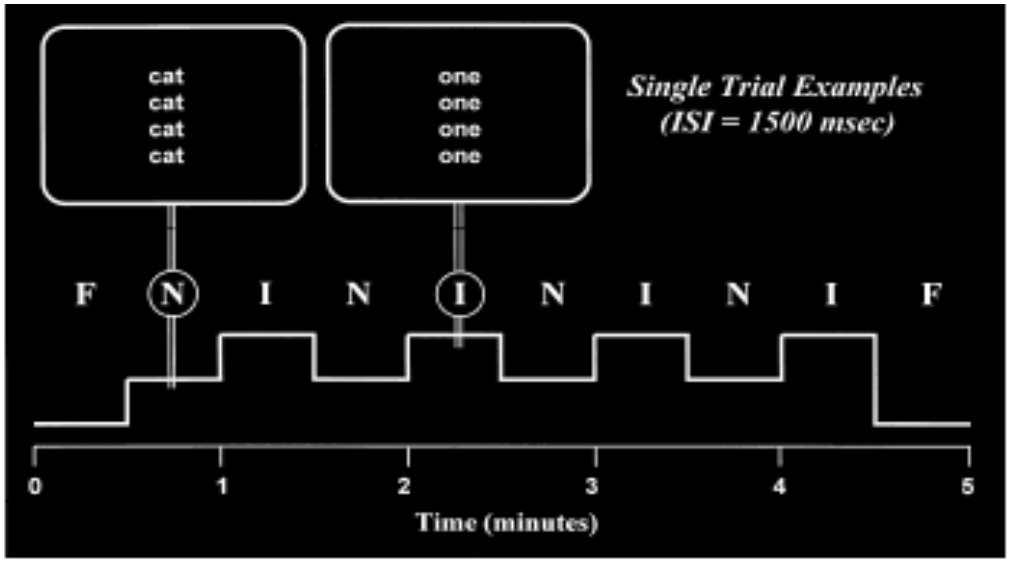
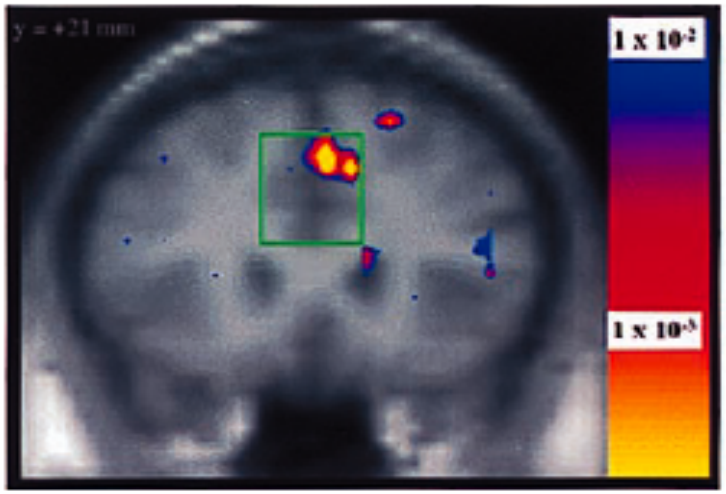
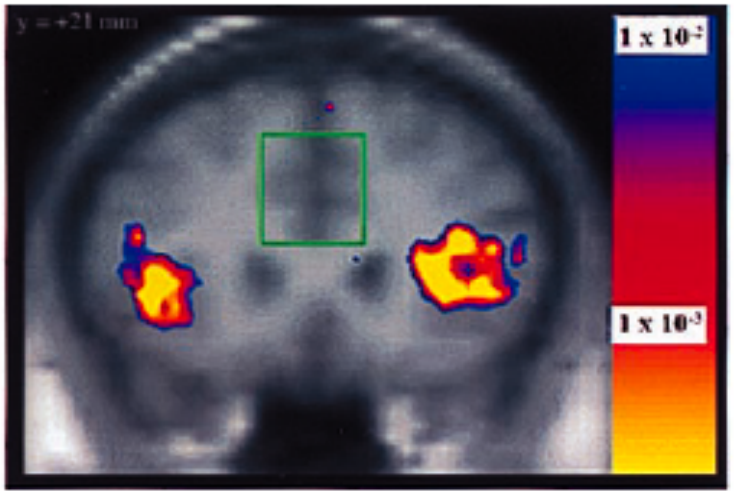


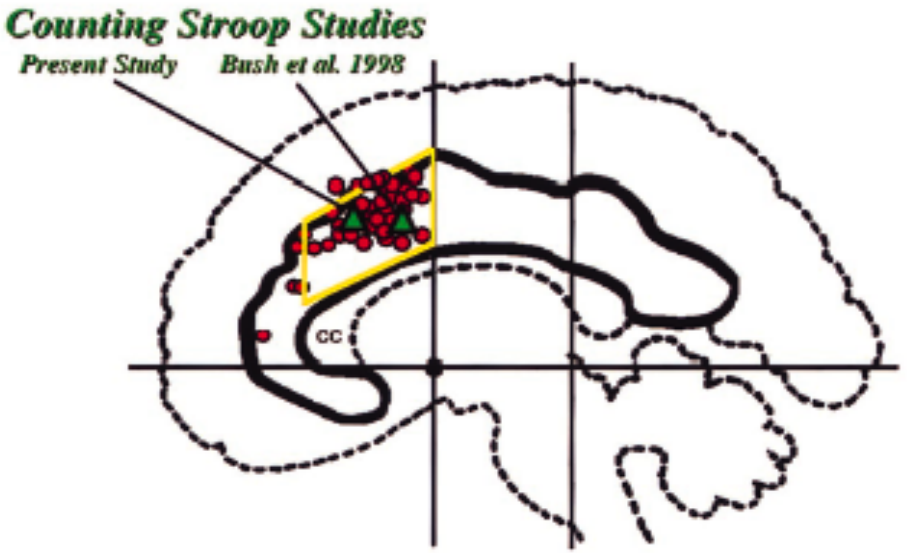
Figure 1. The Counting Stroop task: trial examples and block design. The top portion of this combination figure depicts examples of single trials for the two types of stimuli. Subjects were told that they would see sets of one to four identical words appear on the screen, and were instructed to report, via button-press, the number of words in each set, regardless of word meaning. During "neutral" trials, common animal names (dog, cat, bird, or mouse) were used. During "interference" blocks, the words consisted of number names (one, two, three, or four).

Normal Controls

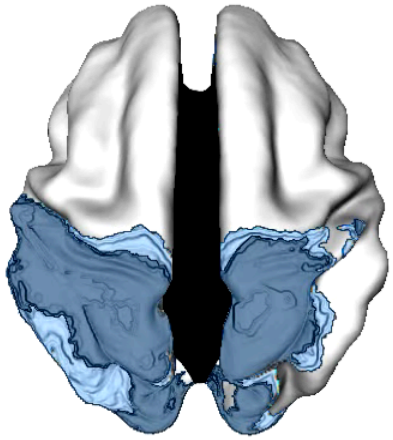


ADHD

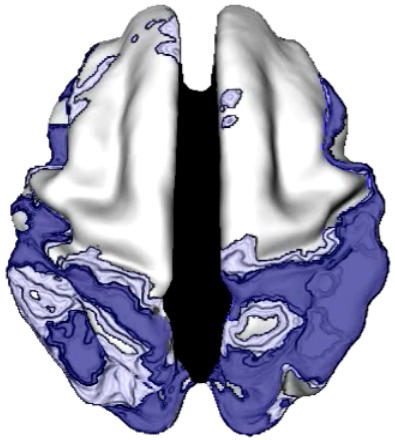




AGE: 5

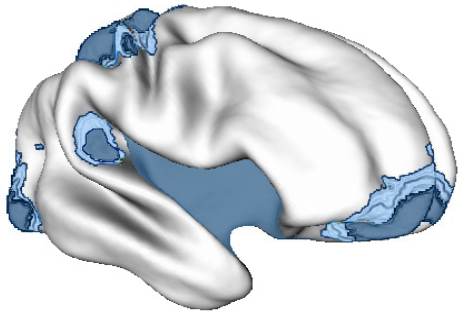


ADHD

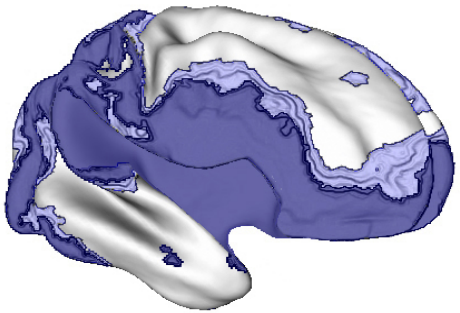


TYPICALLY DEVELOPING CONTROLS

AGE: 6



ADHD



TYPICALLY DEVELOPING CONTROLS

BMC Psychiatry

BioMed Central

Research article

Open Access

Structural brain change in Attention Deficit Hyperactivity Disorder identified by meta-analysis

Ian Ellison-Wright*[1,3], Zoë Ellison-Wright[2] and Ed Bullmore[3]

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* Corresponding author

Published: 30 June 2008

Received: 7 May 2008

Méta-analyse de 7 études de la substance grise (143 témoins vs 114 patients TDAH) : seule significativité = putamen/pallidum droit

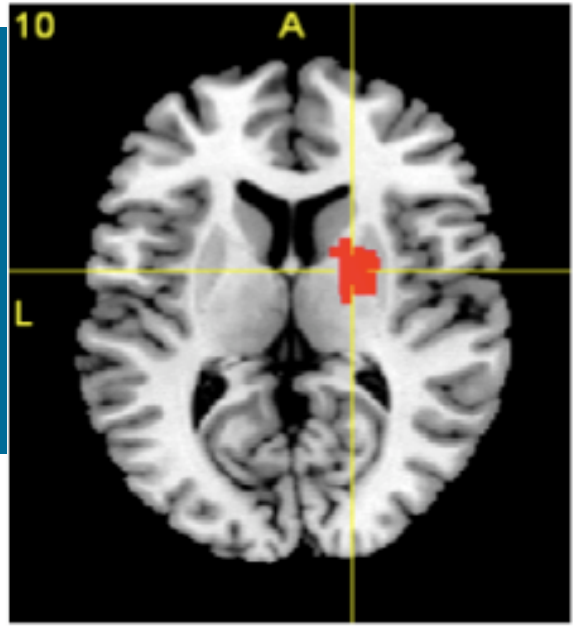


Figure 1
Gray Matter Decreases in ADHD. A transverse section at Talairach space level z = 10 showing gray matter reduction in ADHD in the right putamen/globus pallidus region, displayed on a template brain. The right side of the section represents the right side of the brain. Significant clusters were thresholded with a false discovery rate (FDR) at P < 0.05.

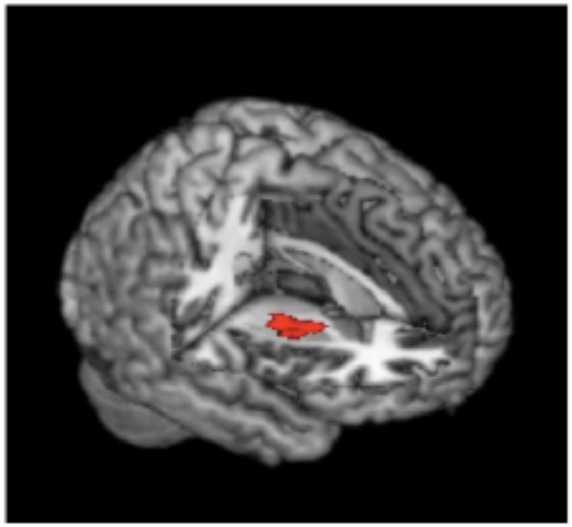


Figure 2
Gray Matter Decreases in ADHD. Gray matter signal decrease in ADHD in the right putamen/globus pallidus region, displayed on a three-dimensional rendered brain with right frontal lobe removed.

ADHD had more lesions localized in the right putamen [23]. Another study of ADHD symptoms in twenty-five children with focal stroke lesions found that the symptoms were most commonly associated with lesions of the

II/ Le modèle alternatif

= défaut des systèmes de la récompense (Sonuga-Barke)
Imagerie fonctionnelle dans des protocoles de récompense

→ Dysfonctionnement des connexions cortico-striatales

Le TDAH lié à une anomalie neurologique du système de la motivation

PsychoMédia - Publié le 09 septembre 2009

L'inattention associée au trouble déficit d'attention et hyperactivité (TDAH) pourrait s'expliquer en partie par la sous-stimulation des centres du cerveau dits de la récompense, impliqués dans la motivation, selon une étude publiée dans le Journal of the American Medical Association.

Les chercheurs ont comparé des images cérébrales de 53 adultes atteints du TDAH, ne prenant pas de médicaments, et 44 personnes n'ayant pas le TDAH.

Les personnes ayant le TDAH présentaient de faibles niveaux de certains récepteurs du neurotransmetteur dopamine dans le mésencéphale et le noyau accumbens, des régions clés du circuit dopaminergique de la récompense, ont constaté Nora D. Volkow du National Institute on Drug Abuse (États-Unis) et ses collègues. De bas niveaux des récepteurs de la dopamine étaient associés avec des résultats plus faibles à des tests d'attention.

"Cela peut expliquer pourquoi les déficits d'attention des personnes atteintes du TDAH sont plus importants dans des tâches qui sont considérées comme ennuyantes, répétitives et inintéressantes ainsi qu'expliquer la propension aux complications telles que la toxicomanie et l'obésité (la dopamine étant impliquée dans les addictions)", écrivent les auteurs.

PRELIMINARY COMMUNICATION

Evaluating Dopamine Reward Pathway in ADHD

Clinical Implications

Nora D. Volkow, MD
Gene-Jack Wang, MD
Scott H. Kollins, PhD
Tim L. Wigal, PhD
Jeffrey H. Newcorn, MD
Frank Telang, MD
Joanna S. Fowler, PhD
Wei Zhu, PhD
Jean Logan, PhD

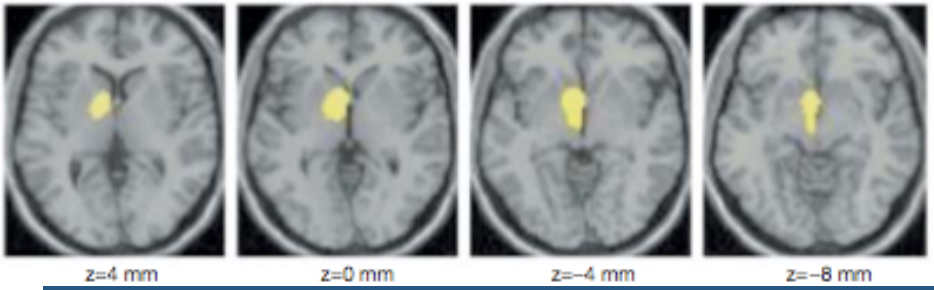
Context Attention-deficit/hyperactivity disorder (ADHD)—characterized by symptoms of inattention and hyperactivity-impulsivity—is the most prevalent childhood psychiatric disorder that frequently persists into adulthood, and there is increasing evidence of reward-motivation deficits in this disorder.

Objective To evaluate biological bases that might underlie a reward/motivation deficit by imaging key components of the brain dopamine reward pathway (mesoaccumbens).

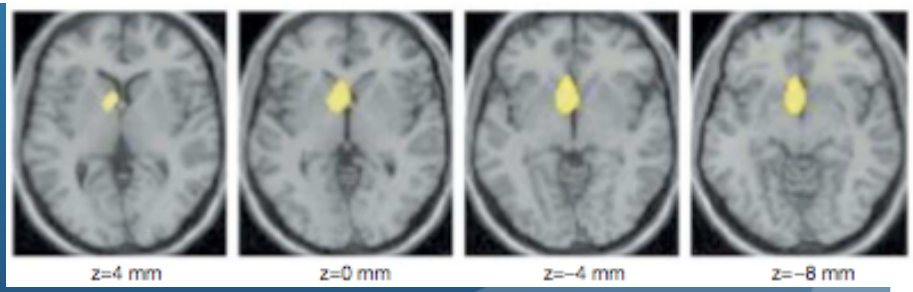
Design, Setting, and Participants We used positron emission tomography to measure dopamine synaptic markers (transporters and D_2/D_3 receptors) in 53 nonmedicated adults with ADHD and 44 healthy controls between 2001-2009 at Brookhaven National Laboratory.

Main Outcome Measures We measured specific binding of positron emission tomographic radioligands for dopamine transporters (DAT) using [^{11}C]cocaine and for D_2/D_3 receptors using [^{11}C]raclopride, quantified as binding potential (distribution volume ratio −1).

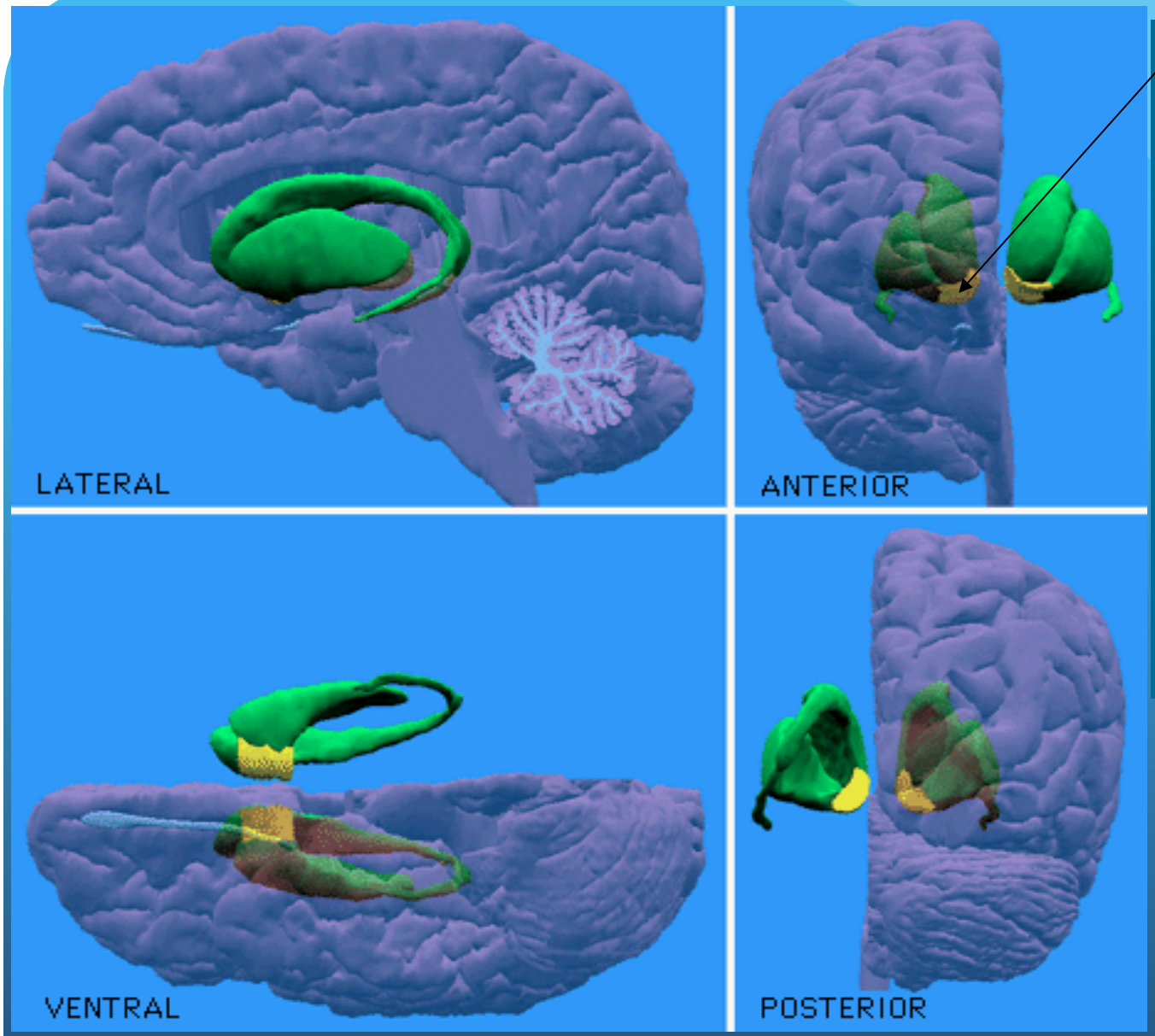
Results For both ligands, statistical parametric mapping showed that specific binding was lower in ADHD than in controls (threshold for significance set at $P < .005$) in regions



Dopamine D 2/D3 receptor availability



Dopamine transporter availability



Noyau accumbens
Chez l'animal : en activité lors de l'anticipation d'une récompense, l' évaluation de la magnitude d'une récompense
Chez l'homme impliqué dans les conduites à risque et addictives

Ventral Striatal Hyporesponsiveness During Reward Anticipation in Attention-Deficit/Hyperactivity Disorder

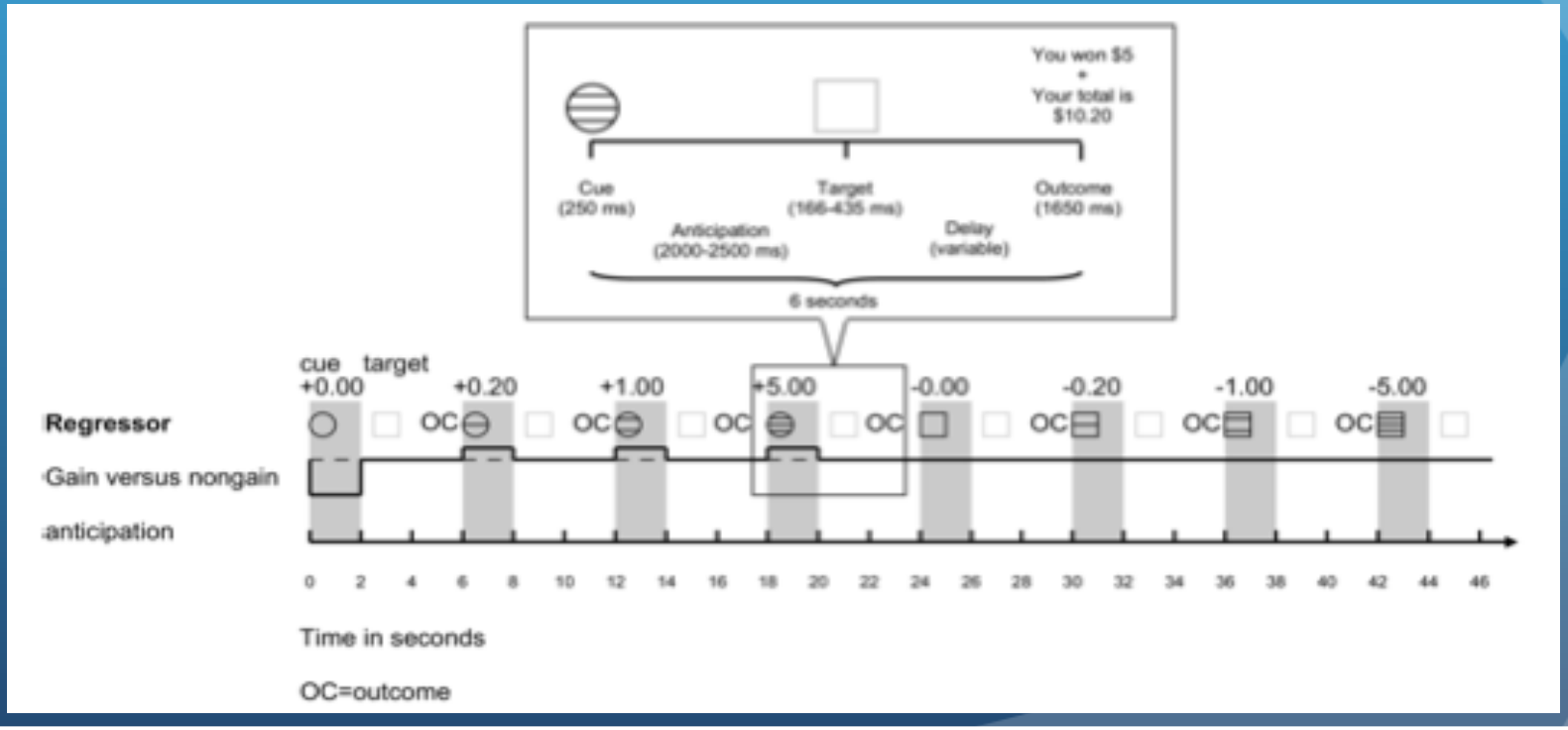
Anouk Scheres, Michael P. Milham, Brian Knutson, and Francisco Xavier Castellanos

Background: Although abnormalities in reward processing have been proposed to underlie attention-deficit/hyperactivity disorder (ADHD), this link has not been tested explicitly with neural probes.

Methods: This hypothesis was tested by using fMRI to compare neural activity within the striatum in individuals with ADHD and healthy controls during a reward-anticipation task that has been shown previously to produce reliable increases in ventral striatum activity in healthy adults and healthy adolescents. Eleven adolescents with ADHD (5 off medication and 6 medication-naïve) and 11 healthy controls (ages 12–17 y) were included. Groups were matched for age, gender, and intelligence quotient.

Results: We found reduced ventral striatal activation in adolescents with ADHD during reward anticipation, relative to healthy controls. Moreover, ventral striatal activation was negatively correlated with parent-rated hyperactive/impulsive symptoms across the entire sample.

Conclusions: These findings provide neural evidence that symptoms of ADHD, and impulsivity or hyperactivity in particular, may involve diminished reward anticipation, in addition to commonly observed executive dysfunction.



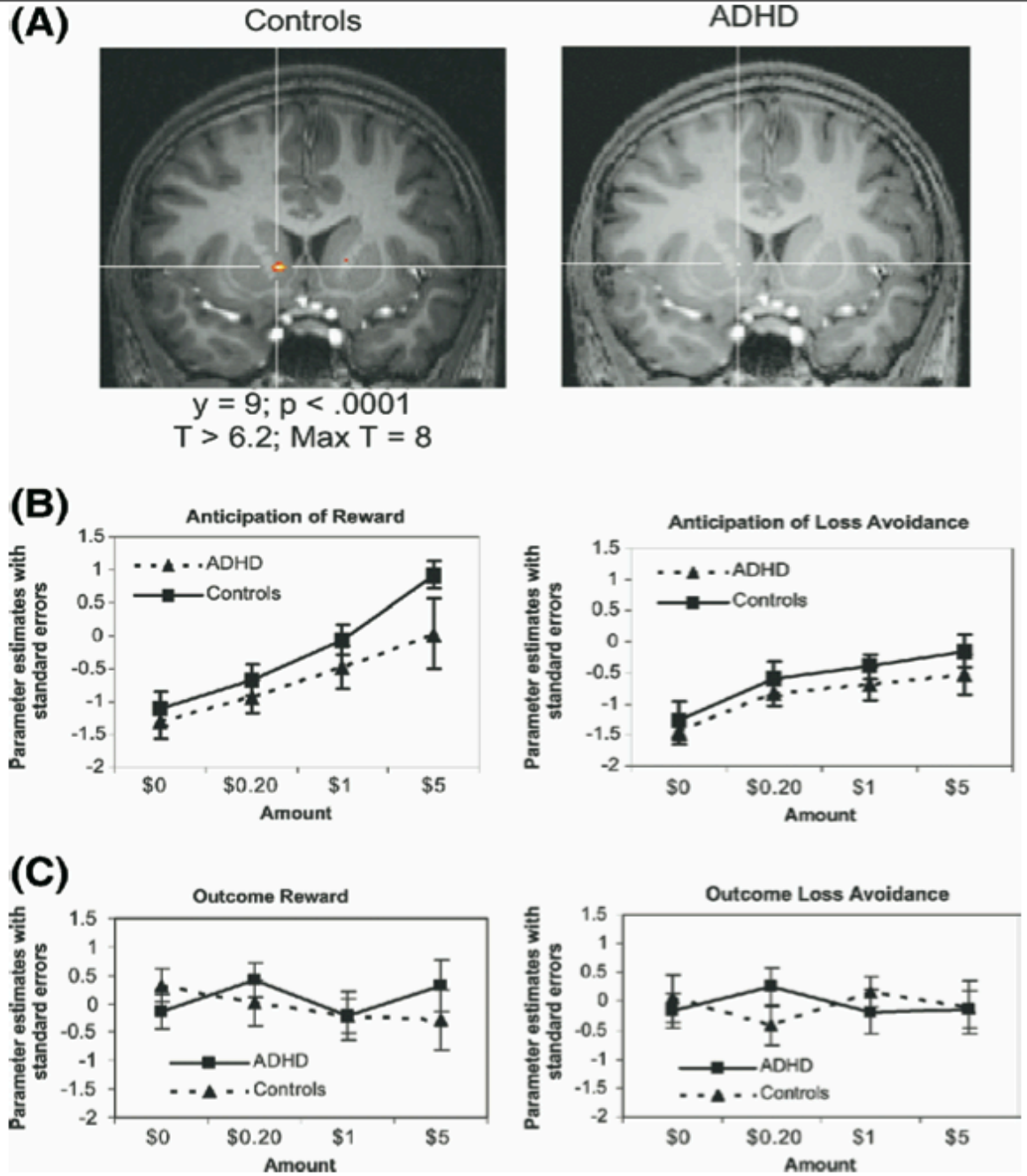


Figure 2. Impact of reward anticipation and outcome on ventral striatum (VS) activity.

TDAH : hypoactivation du striatum ventral lors de l'anticipation de la récompense

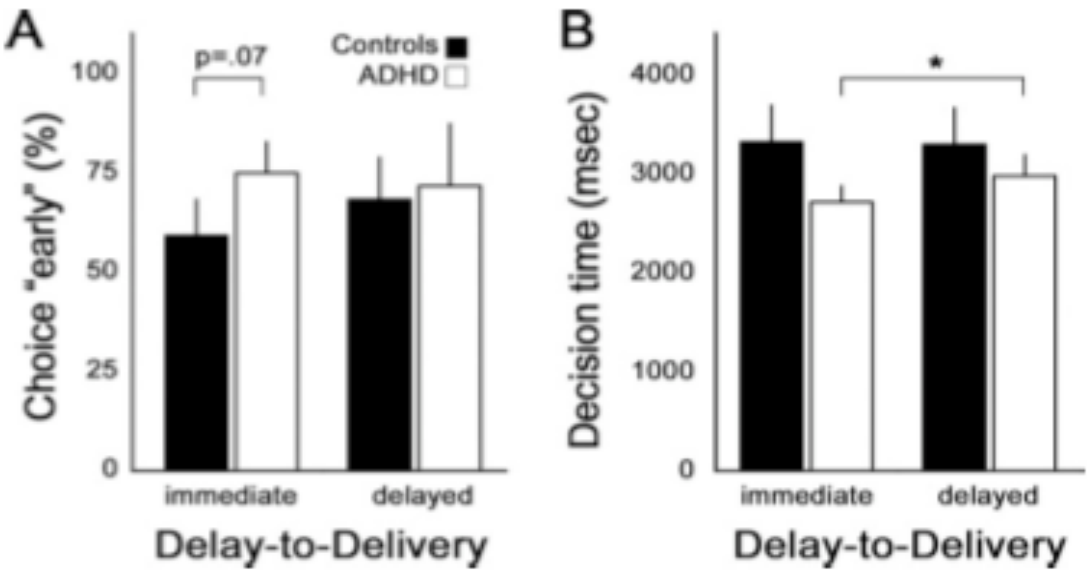
Neural Hyporesponsiveness and Hyperresponsiveness During Immediate and Delayed Reward Processing in Adult Attention-Deficit/Hyperactivity Disorder

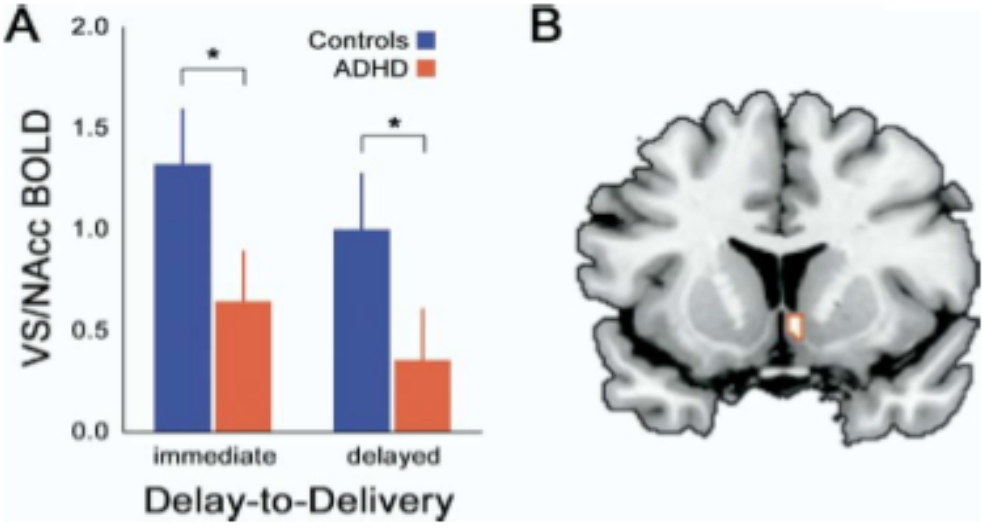
Michael M. Plichta, Nenad Vasic, Robert Christian Wolf, Klaus-Peter Lesch, Dagmar Brummer, Christian Jacob, Andreas J. Fallgatter, and Georg Grön

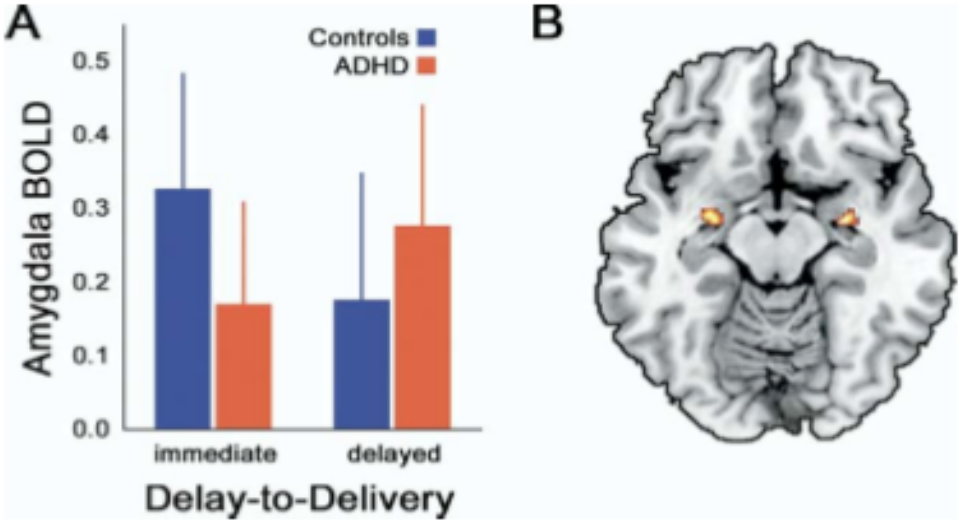
BIOL PSYCHIATRY 2009;65:7–14
© 2009 Society of Biological Psychiatry

ADHD : hyporesponsiveness of the ventral-striatal reward system for both immediate and delayed rewards

delayed rewards evoked hyperactivation in dorsal caudate nucleus and amygdala of ADHD patients.





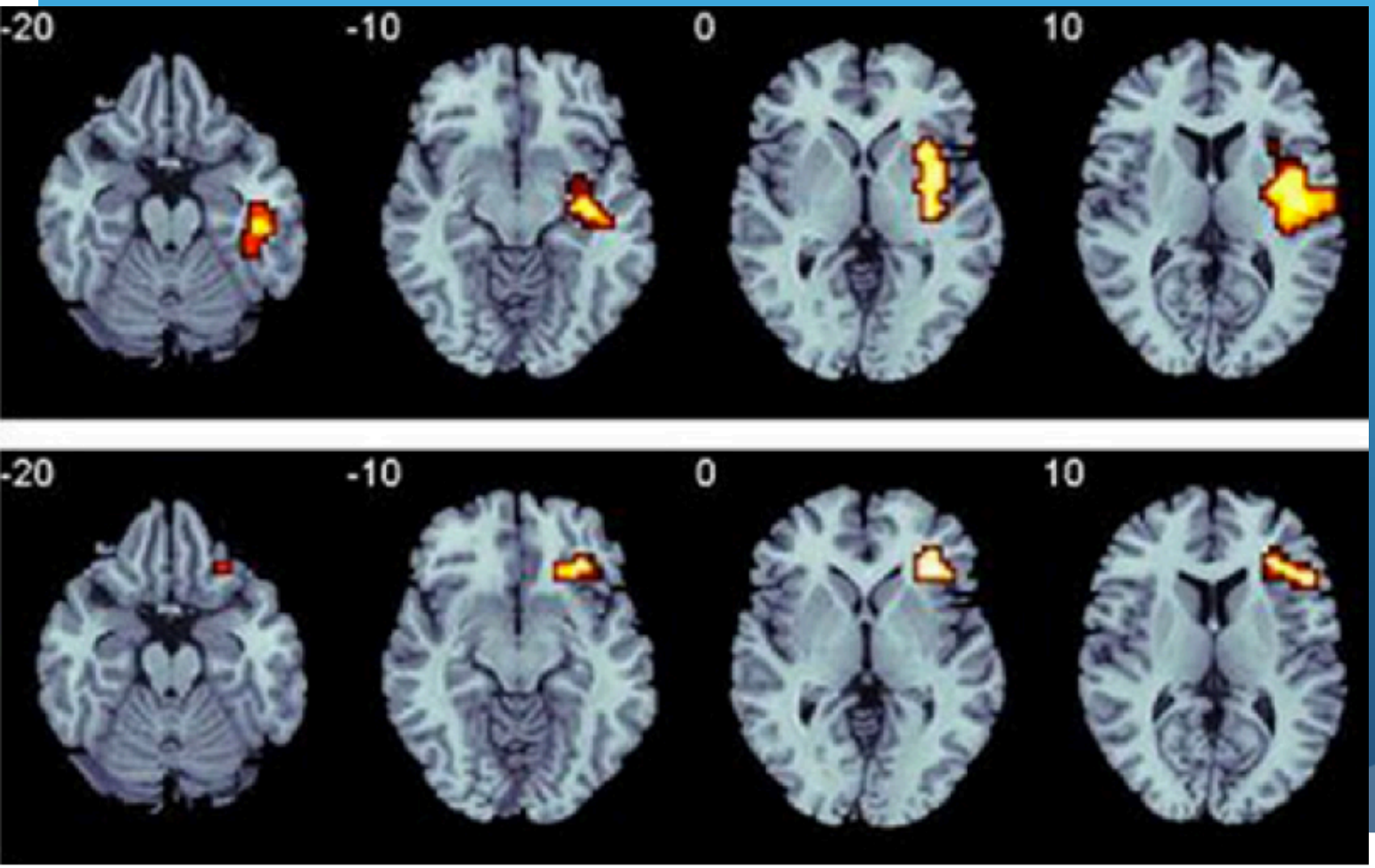


REVIEW

"Cool" Inferior Frontostriatal Dysfunction in Attention-Deficit/Hyperactivity Disorder Versus "Hot" Ventromedial Orbitofrontal-Limbic Dysfunction in Conduct Disorder: A Review

Katya Rubia

Areas of hypoactivation in CD children compared to ADHD and controls



Sustained attention

(Hippoc.+insula)

Reward

(ventro-lateral orbital)

A review of fronto-striatal and fronto-cortical brain abnormalities in children and adults with Attention Defic Hyperactivity Disorder (ADHD) and new evidence for dysfunction in adults with ADHD during motivation and attention

*Ana Cubillo, Rozmin Halari, Anna Smith, Eric Taylor and Katya Rubia**

Department of Child Psychiatry, King's College London, Institute of Psychiatry, London, UK

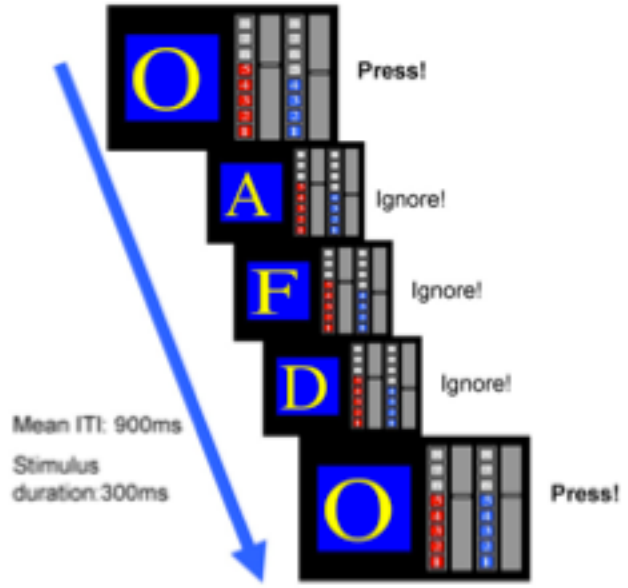
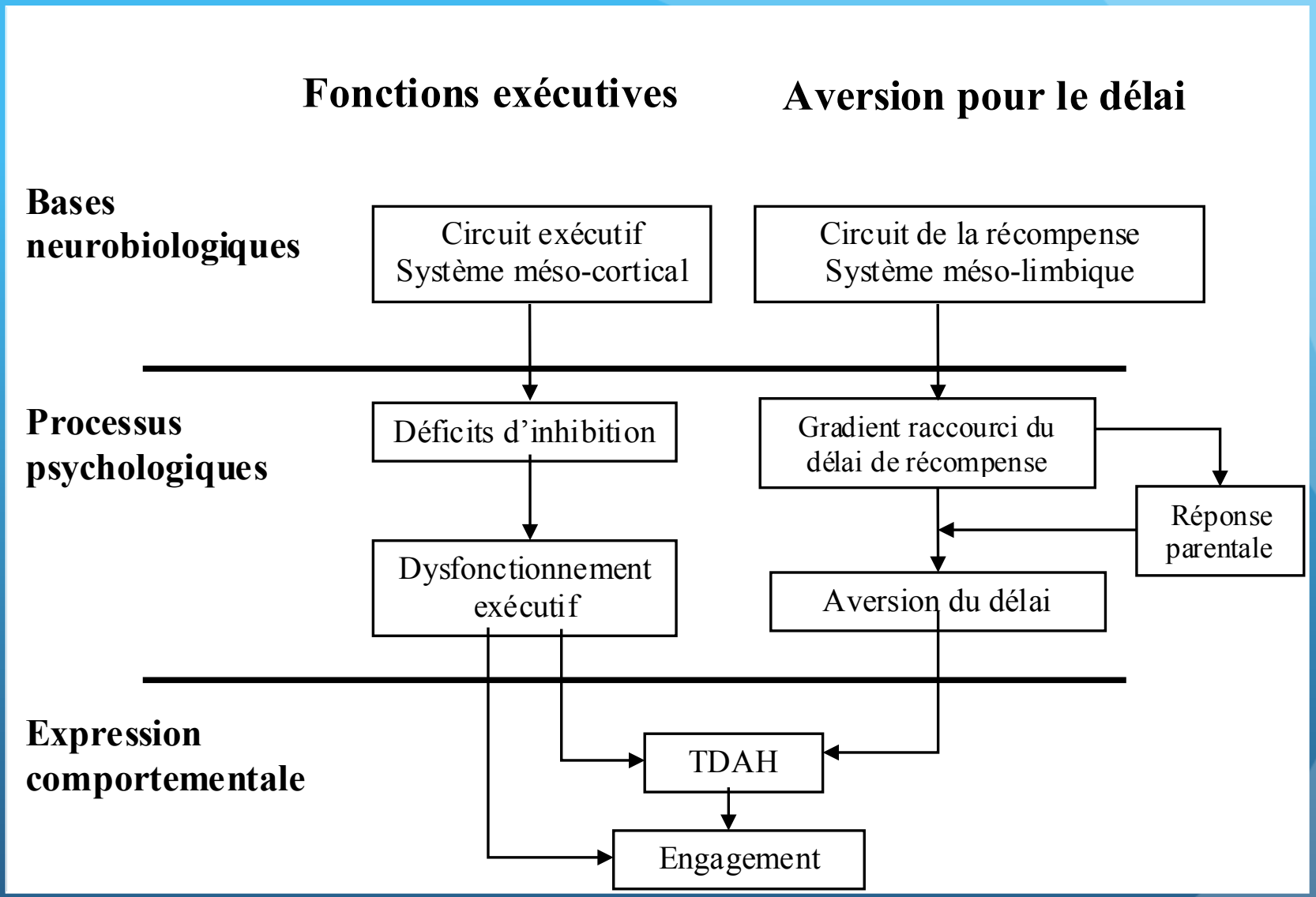


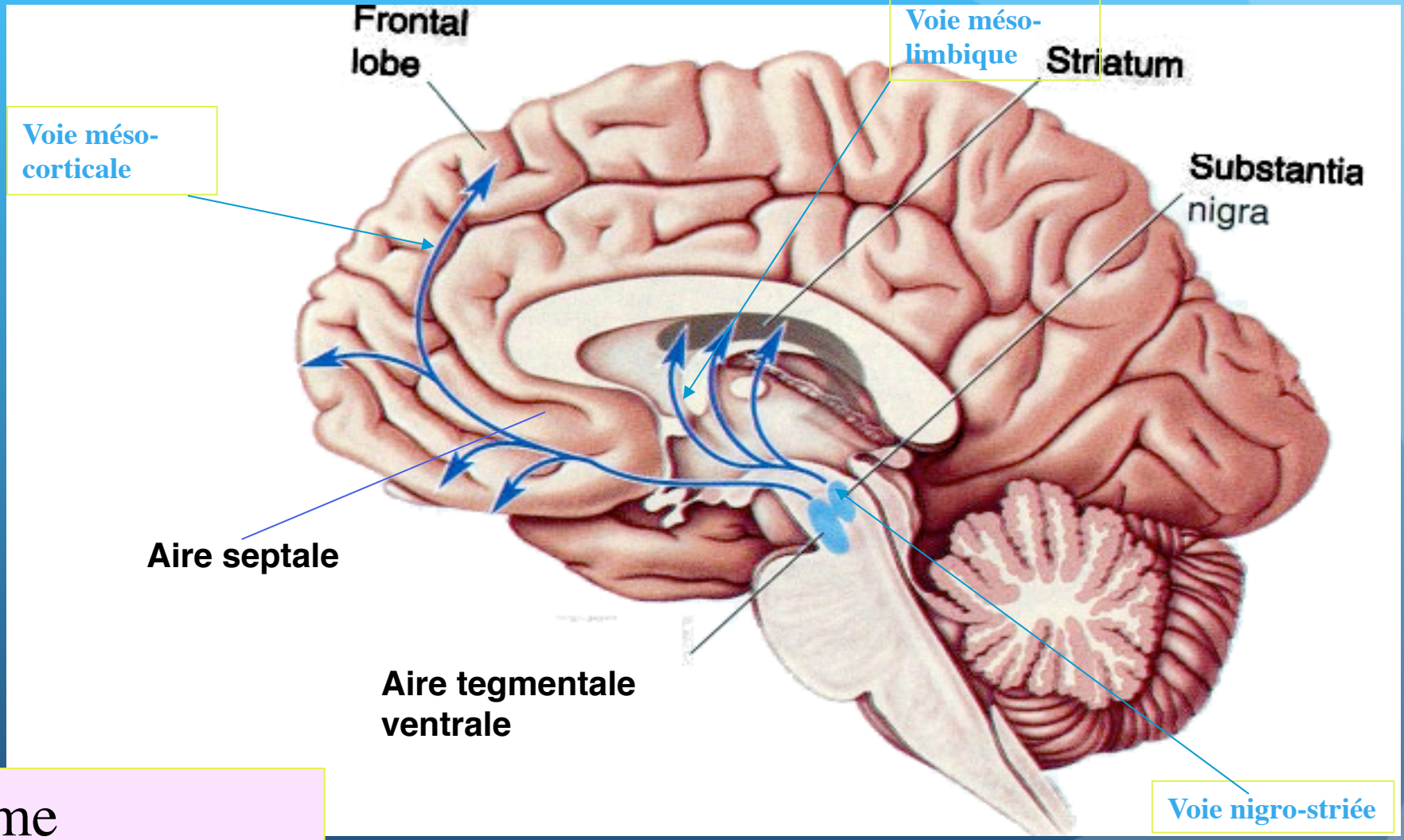
Fig. 1 – Schematic illustration of the Rewarded Continuous Performance Test. Response required to "X" or "O", not to any other letters. Reward is given for each response to one of the two target letters (which letter was rewarded was randomised across subjects). Red/blue bars indicate correct responses to targets (X/O). Three correct responses make one score on the bar for the rewarded and non-rewarded targets, but only the rewarded target scores are remunerated with £1. Up to £8 can be won on the task.

Comparaison adulte/enfant :
tâche d'attention soutenue :
hypoactivation fronto-pariéto-striatale (comme chez l'enfant)
Tâche récompensée :
hypoactivation ventro-médiane, mais seulement si trouble des conduites comorbide

Rewarded CPT
1£ pour 3 bonnes réponses (hits)

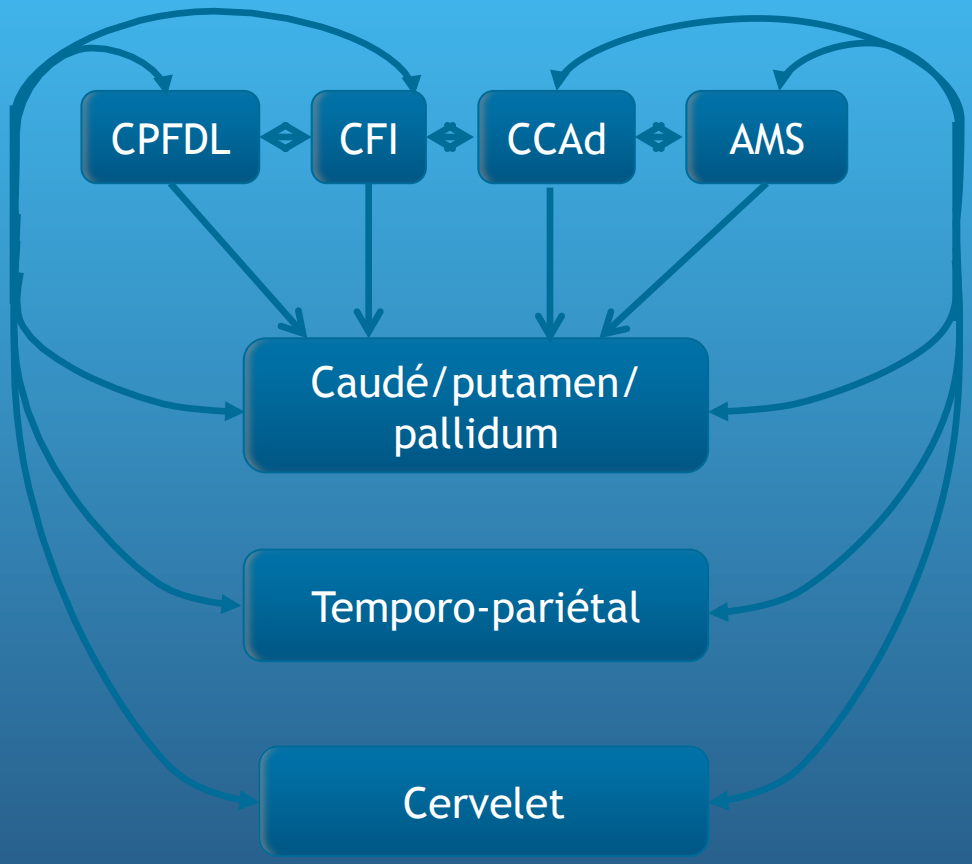


Physiopathologie du TDAH (D'après Sonuga-Barke, 2002, 2003)

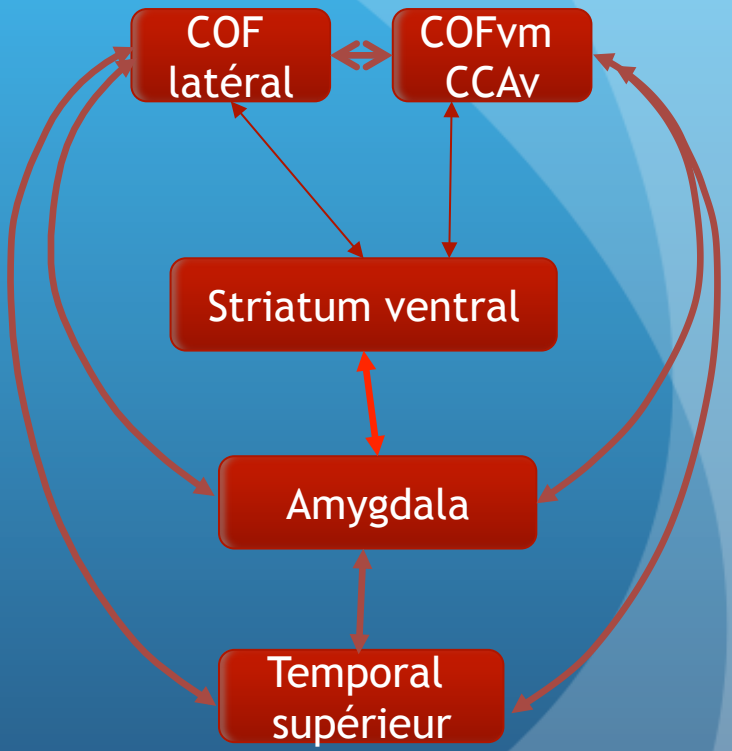


Système dopaminergique

Fonctions exécutives « froides »



Fonctions exécutives « chaudes »



Conclusion

- La dysfonction des systèmes exécutifs « froids », sous-tendus par le cortex frontal latéral, reste une explication valide de la limitation des capacités attentionnelles, en particulier l'attention soutenue
- L'impulsivité et l'aversion au délai (« hot-executive »), sous-tendus par les circuits à origine orbito-frontale, seraient plutôt liés à un défaut d'ajustement des systèmes de la récompense, en particulier lors de comorbidité avec des troubles des conduites
- Il y a de forts arguments, en particulier anatomiques, pour présumer que le primum movens est une dysfonction au niveau des circuits de la récompense et que les autres systèmes sont secondairement dysfonctionnels
- Un défaut de connectivité de divers circuits cortico-corticaux et cortico-sous-corticaux pourrait rendre compte de ces déficits, et aussi de l'activité mentale spontanée matéralisée par l'activité de repos dans le circuit « default-mode ».