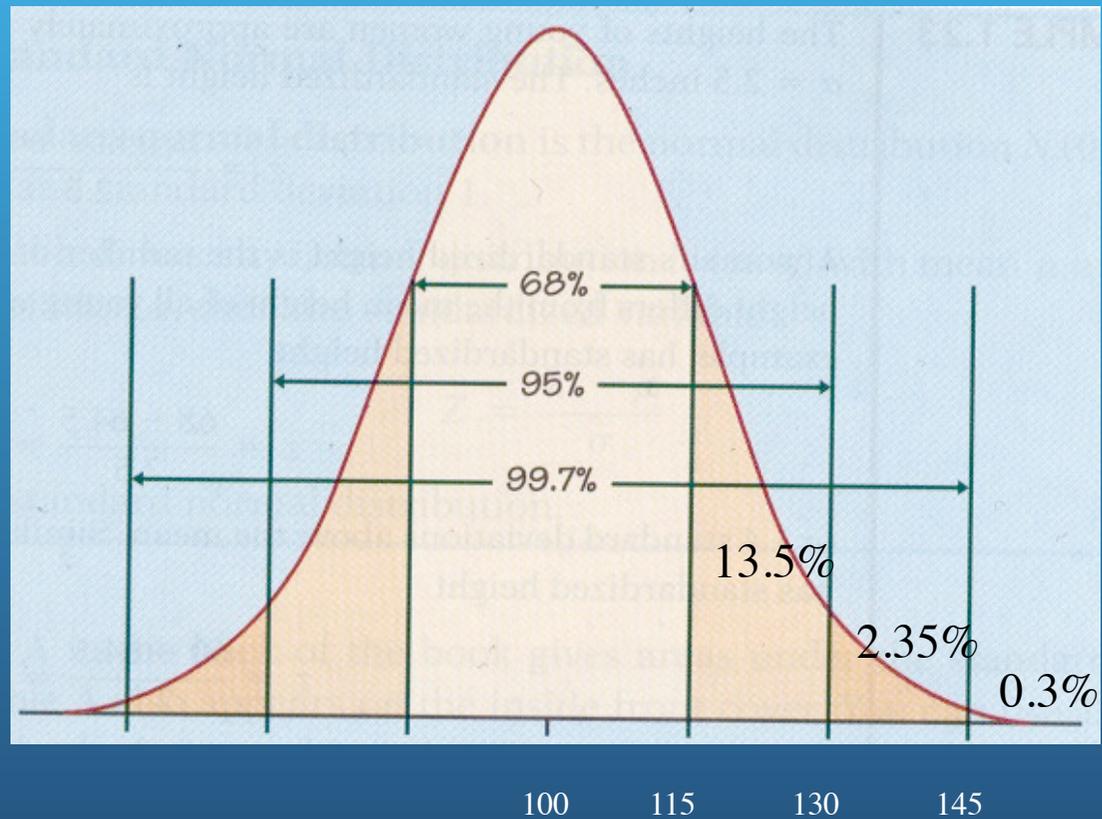


Approche neuropsychologique et neurocognitive de la précocité intellectuelle

Michel Habib, neurologue
CHU de Marseille

Distribution "normale"

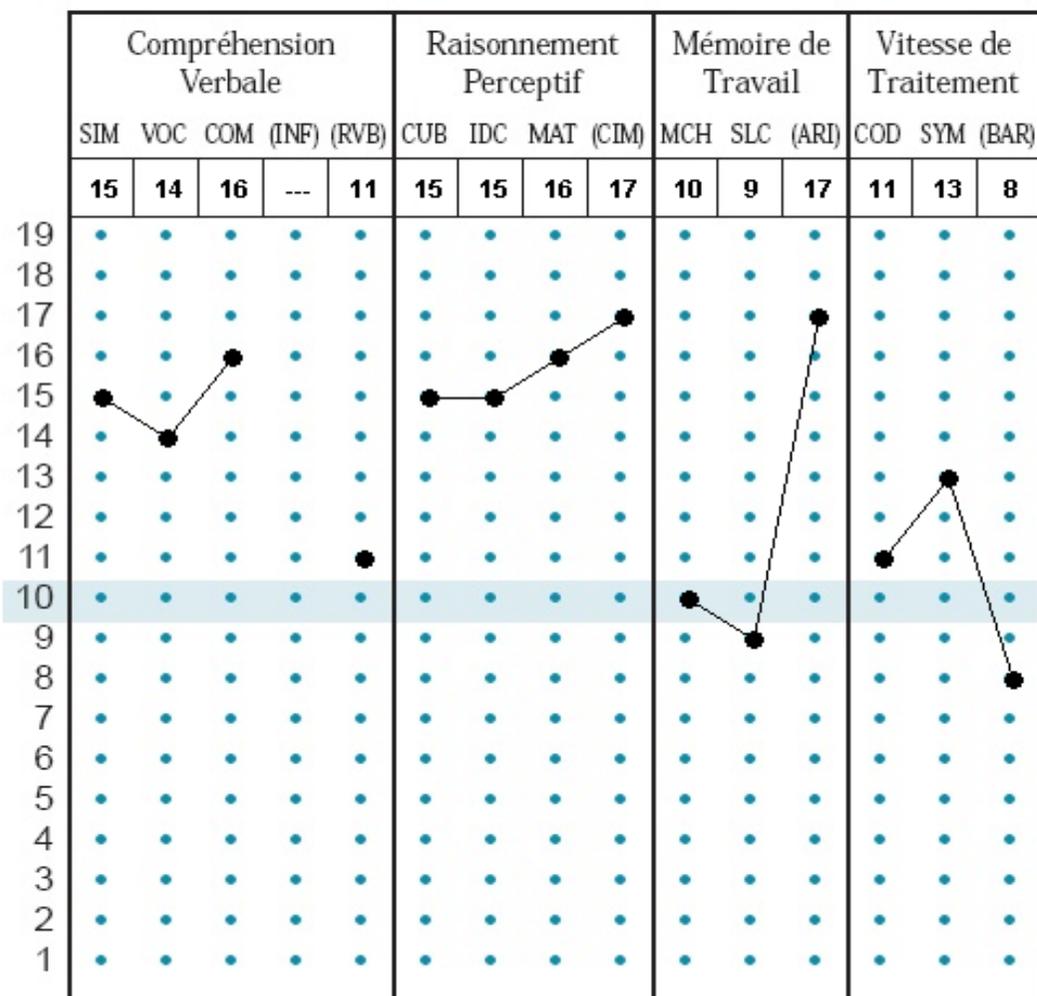


Precocité : théorique < à 2%/ observé : $21/209 = >10\%$

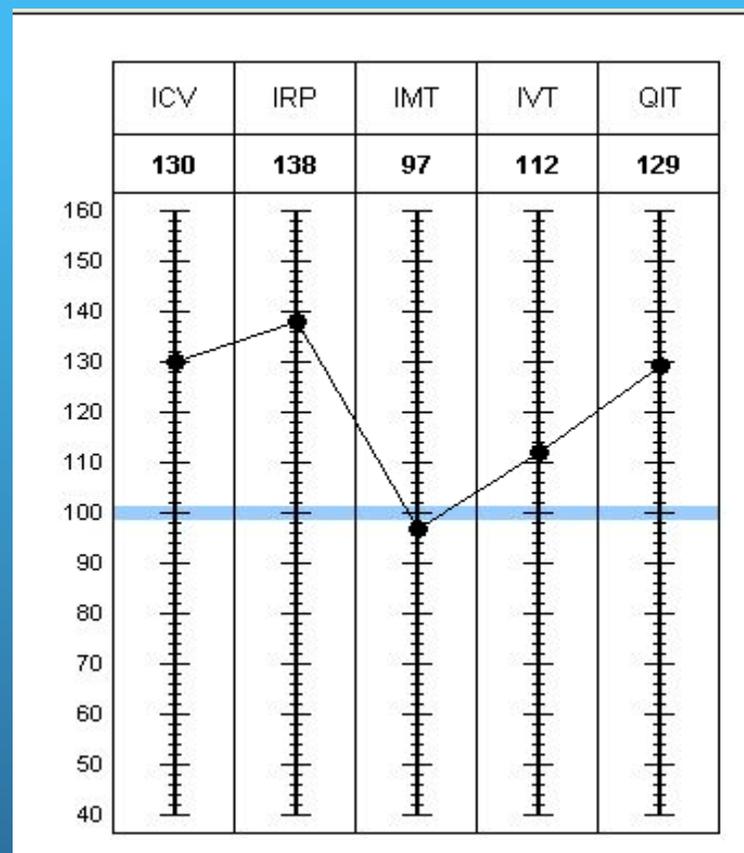
Caractéristiques des HP avec troubles (spécifiques) d'apprentissage

À propos de 20 enfants et adolescents HP reçus dans un centre de référence des troubles d'apprentissage

Profil des notes standard

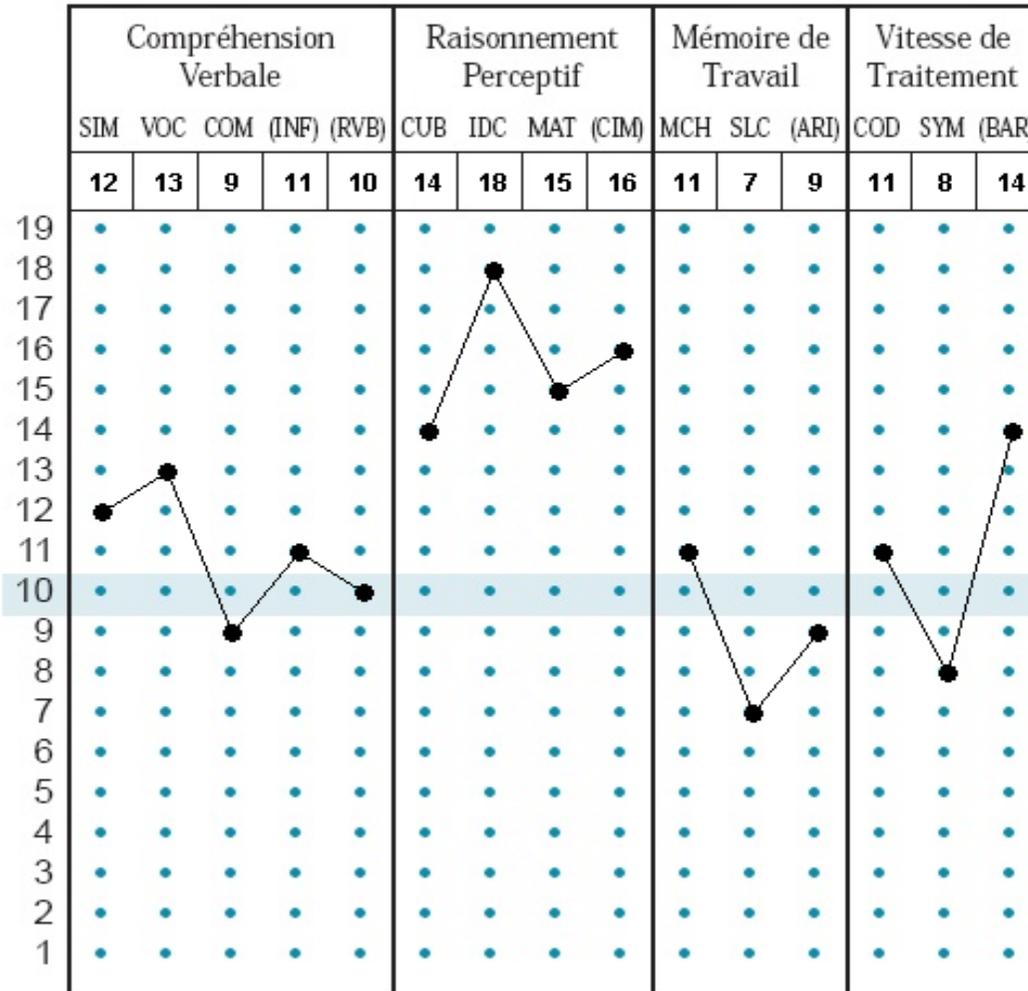


A... Perrine 8;11

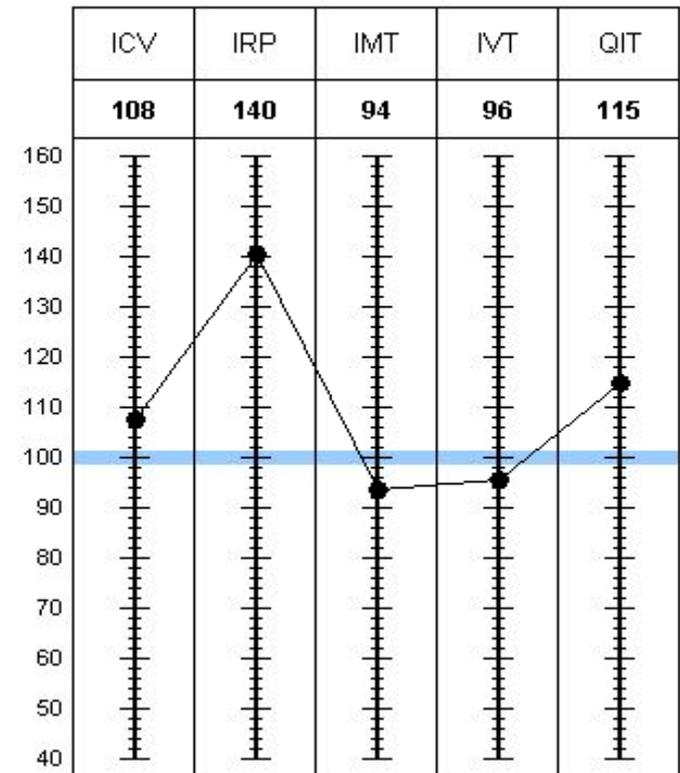


On relève par ailleurs des difficultés certes modérées mais patentes concernant la sphère attentionnelle à savoir un défaut de mémoire de travail, composante attentionnelle de la mémoire, ne permettant pas toujours à Perrine de simultanément stocker et traiter les données en mémoire. Cette limitation se répercute dans les tâches à charge cognitive élevée et plus largement au niveau de la vitesse de traitement des informations

Profil des notes standard



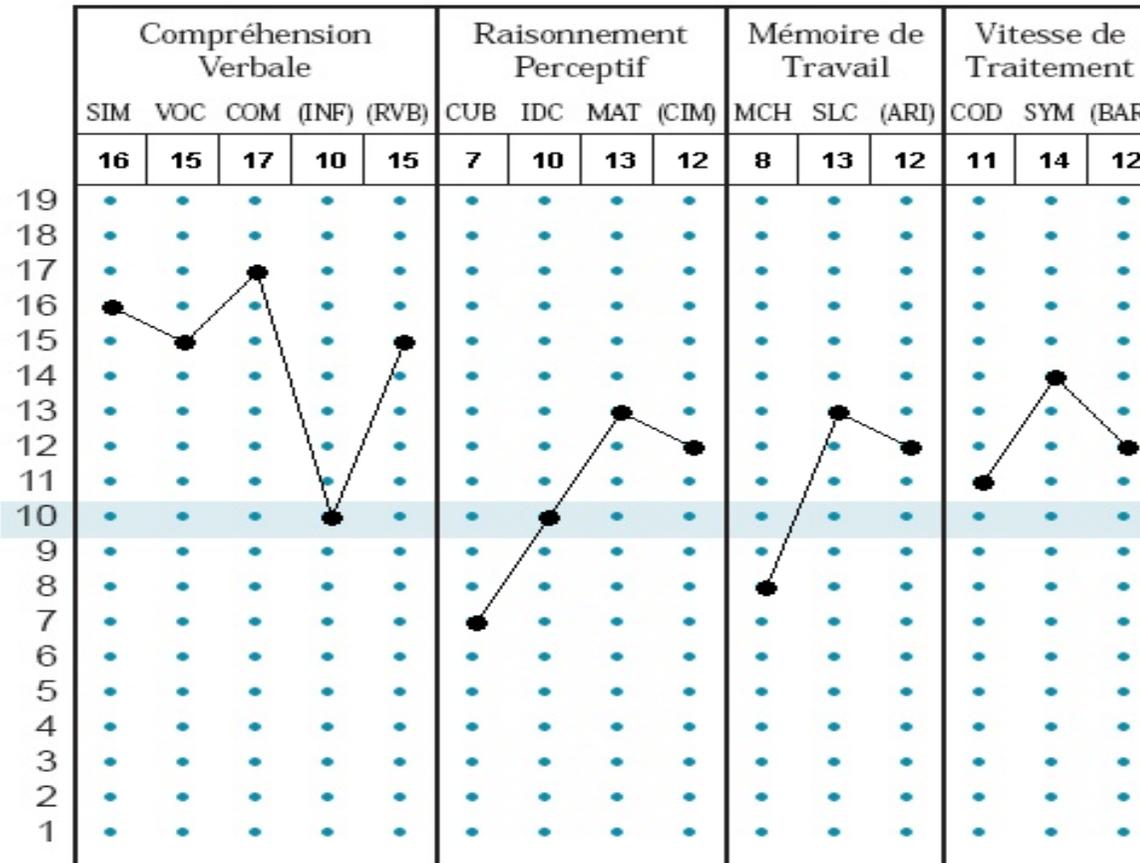
Profil des notes composites



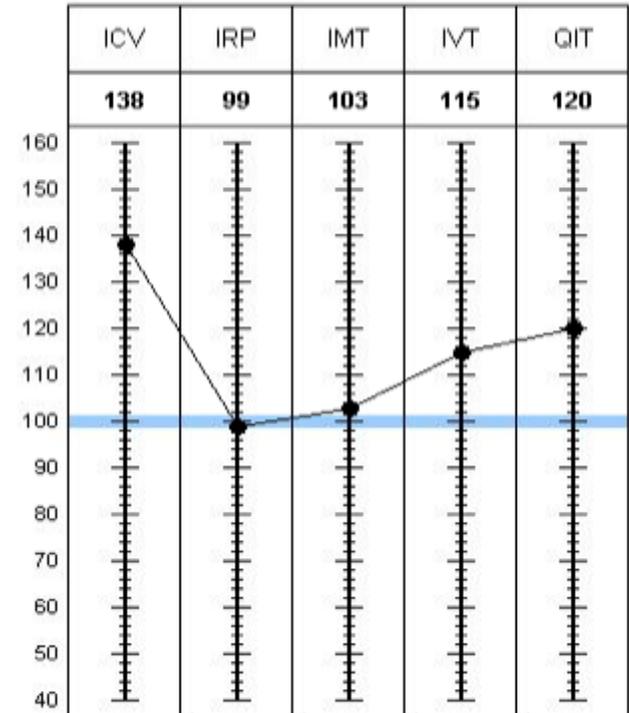
C... Mathis (13,2)

Motif : situation d'exclusion scolaire, tr des conduites

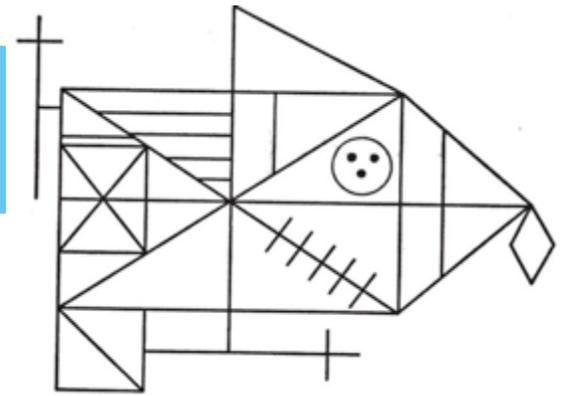
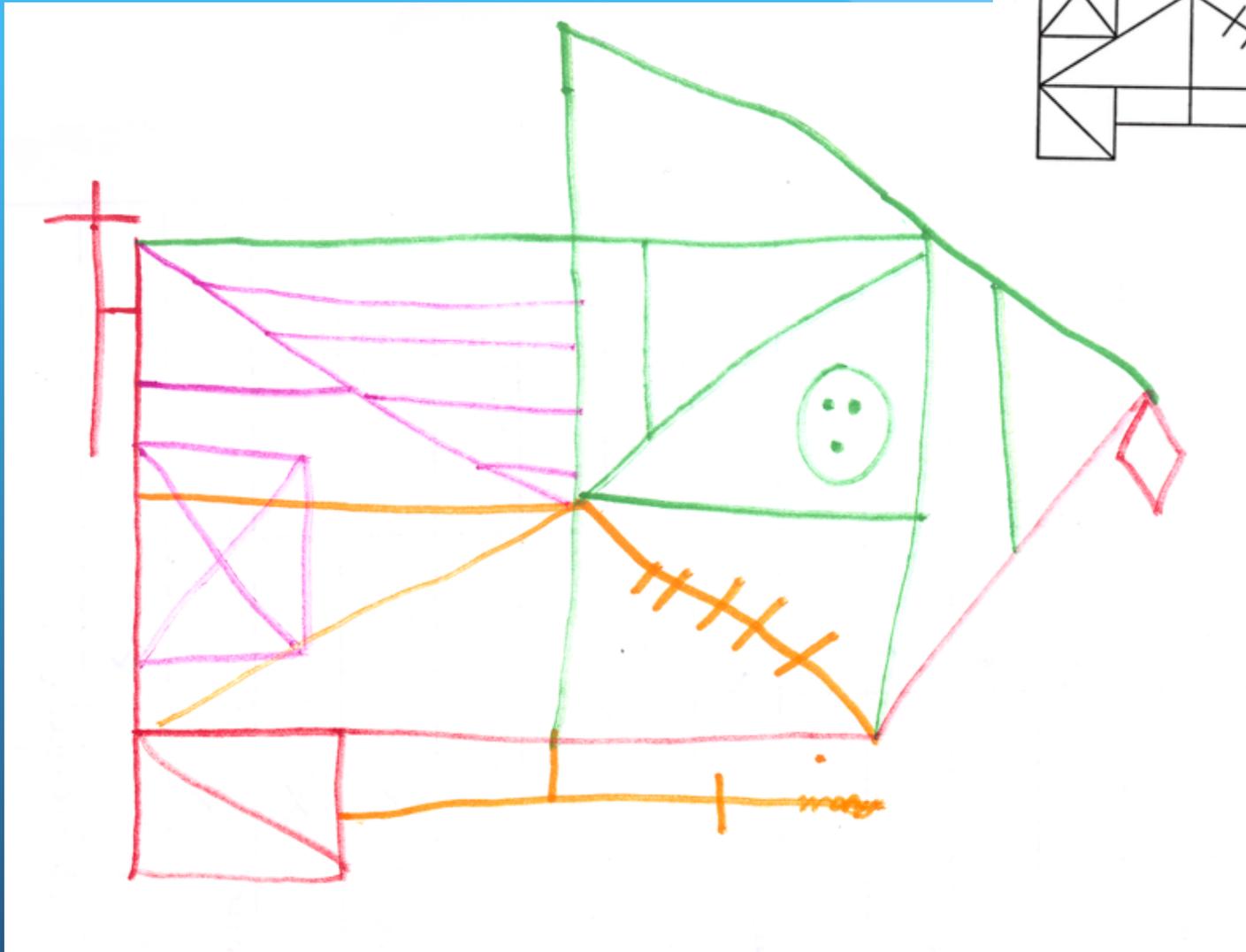
Profil des notes standard



M... Félix (13;2)



Motif : tr comportement à l'école, travaille peu, perturbe

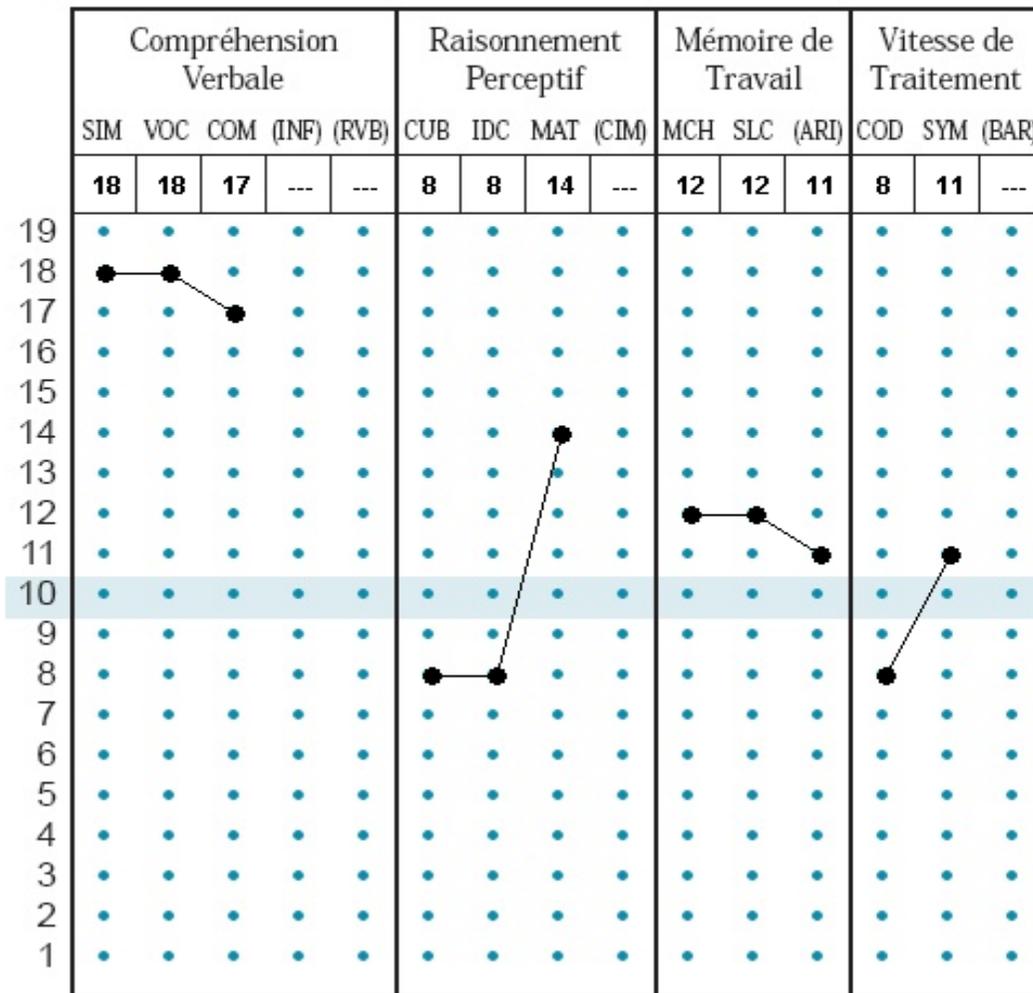


Félix : copie figure de Rey

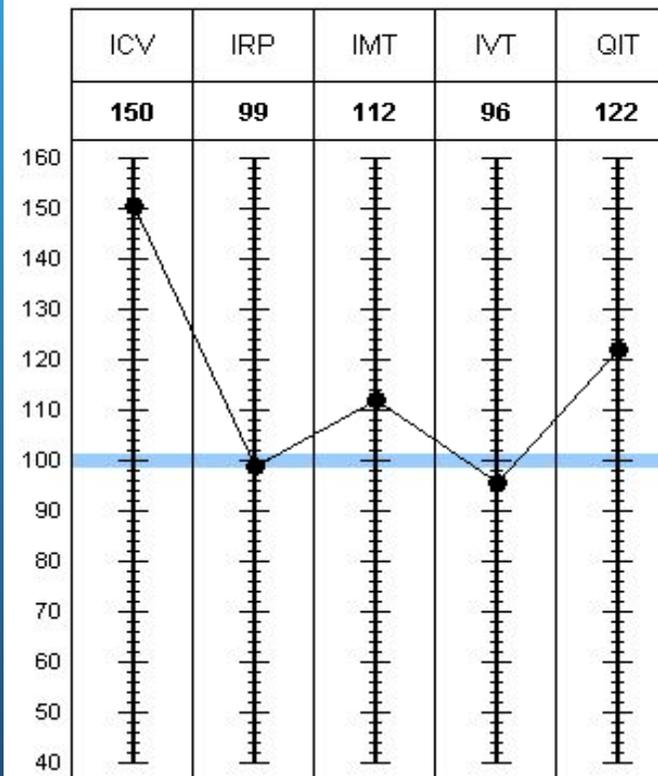
Lolita : 6 ans 11 mois. CE1. aucun retard ni moteur ni langage ni écriture. Lecture acquise après un mois de CP. S'ennuie en classe, turbulente.

Difficultés en mathématiques.

Profil des notes standard

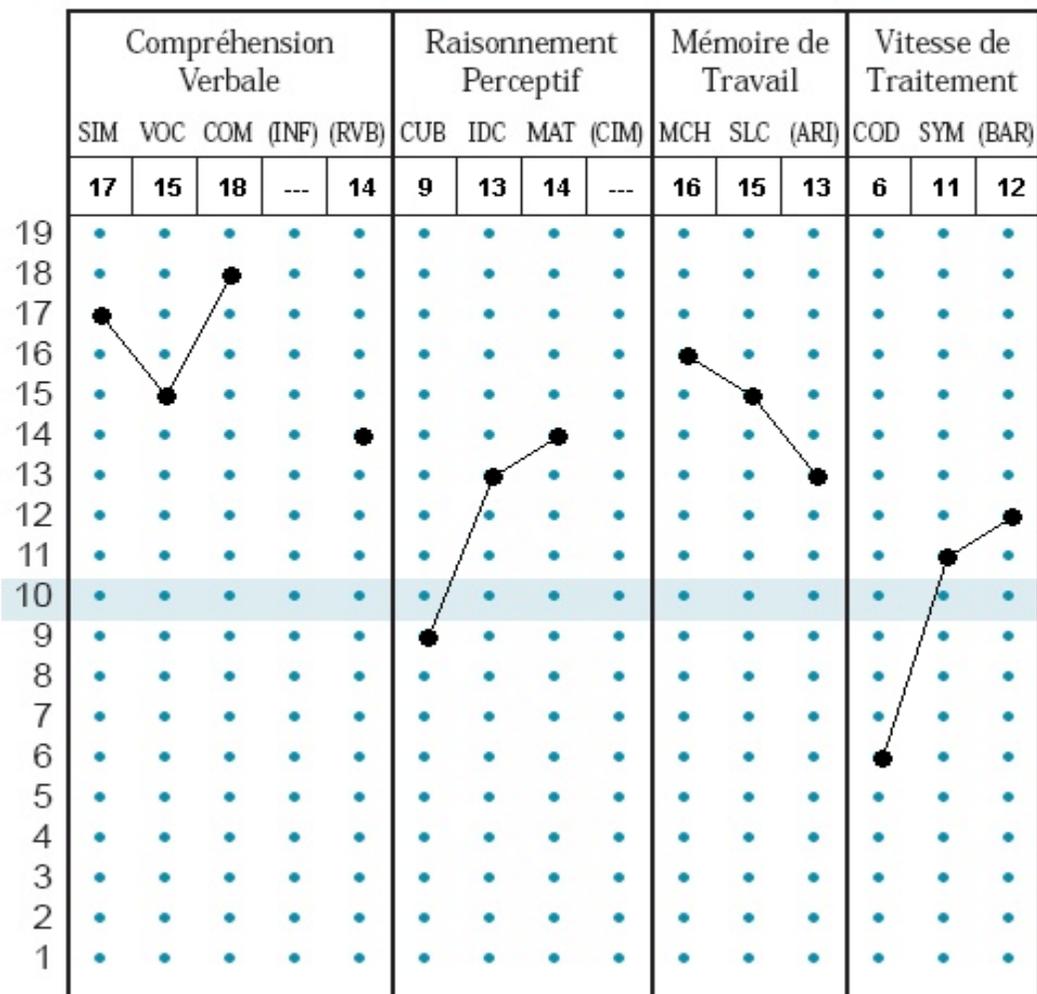


Profil des notes composites

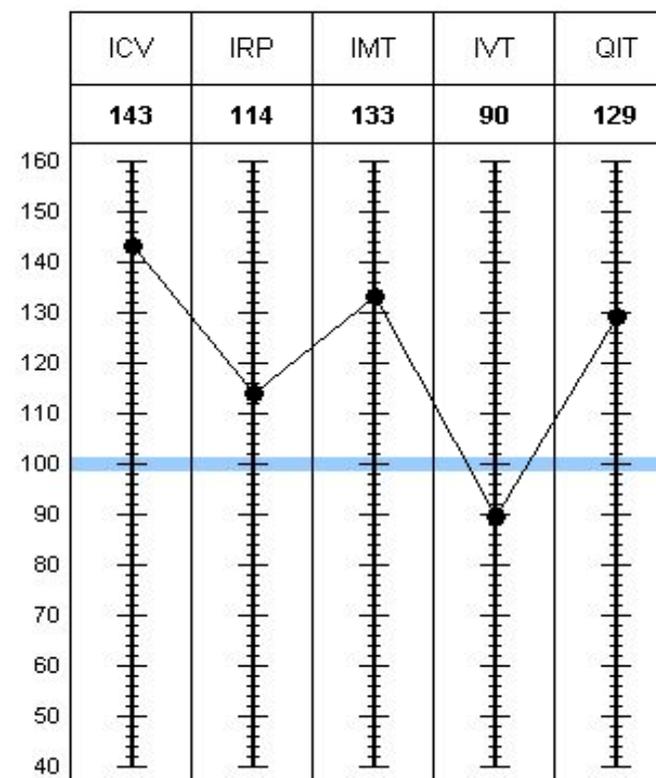


Leny (frère de Lolita) : 10 ans 4 mois. Aucun retard ni de motricité ni de parole mais ne sait pas encore faire ses lacets. Tenue du crayon non acquise. Dysgraphie. Refus de passage à l'écrit. Aucun respect des règles. Comportement à risque et troubles des conduites. Conners-hyperactivité : 22/30

Profil des notes standard



Profil des notes composites



Écriture sous dictée

Dysgraphie patente

Je respire le doux parfum
des fleurs

GRILLE D'EVALUATION PSYCHOMOTRICE

Nom et prénom de l'enfant :

Date de naissance :

Age :

Latéralité :

Main :

Nom du praticien :

Date de passation du bilan :

Œil :

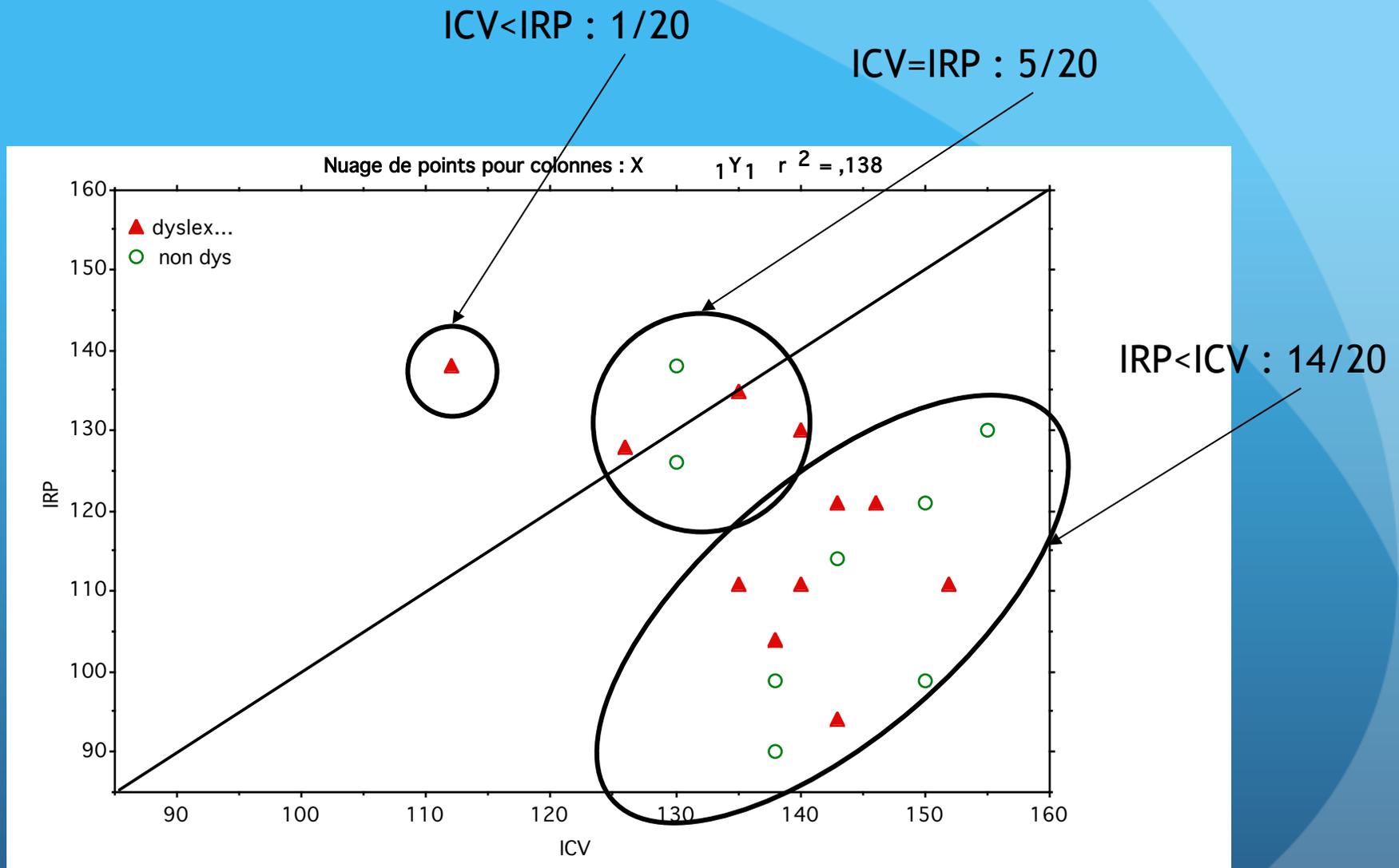
Pied :

Tonus :

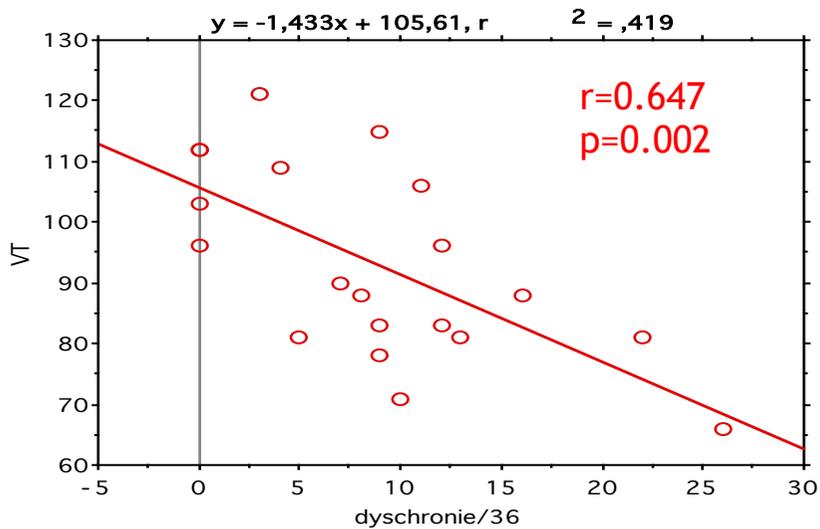
D'action :

De fond :

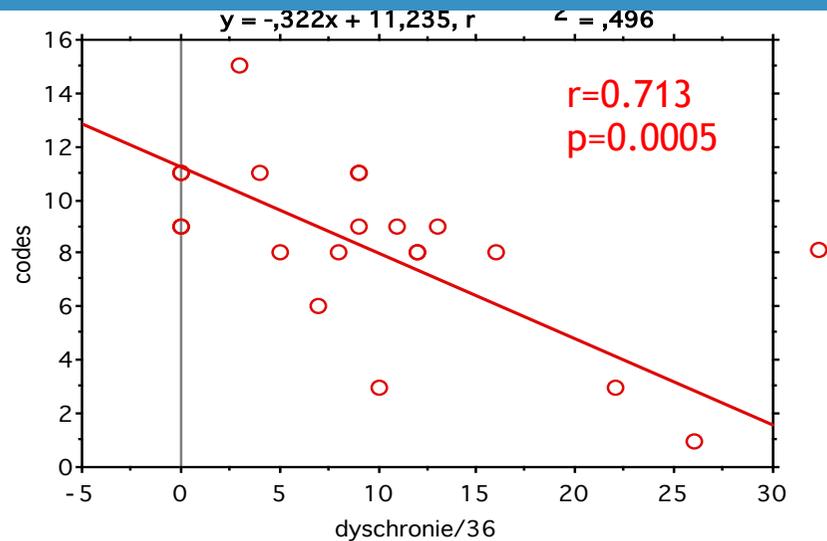
		MOTRICITE GENERALE		COORDINATIONS MANUELLES		SCHEMA CORPOREL			ESPACE		TEMPS		ECRITURE		PLANIFICATION	IMPULSIVITE		
> MOYENNE																		
MOYENNE																		
Déviance de la norme	NORMAL FAIBLE																	
	DISCRETEMENT PATHOLOGIQUE																	
Pathologique	PATHOLOGIQUE																	
	TRES PATHOLOGIQUE																	
		Statique	Dynamique															
		Equilibre	Coordinations globales	Mvts alternatifs	Contrôle et précision	Vitesse des mouvements	Gnoso Praxies manuelles	Somatognosies	Schéma du Bonhomme	Connaissance du vocabulaire	Orientation	Visuo-construction	Connaissance du temps social	Rythmes	Graphie	Rapidité	Planification	Impulsivité



profil cognitif de 20 enfants à fort potentiel intellectuel en difficulté scolaire (dont 12 en difficulté de lecture)

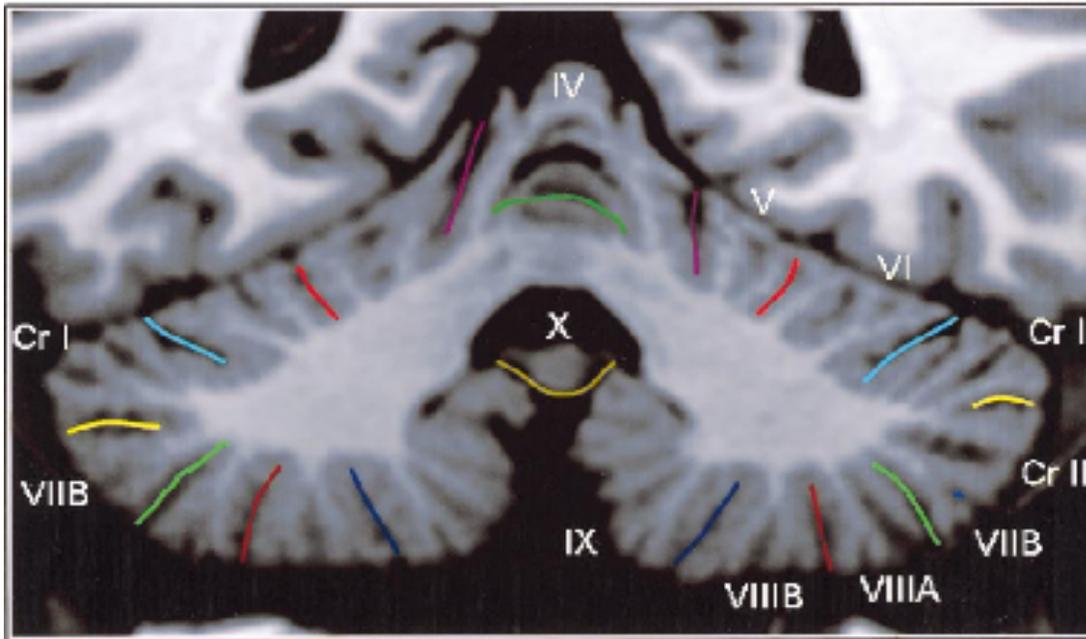


corrélation dyschronie / IVT



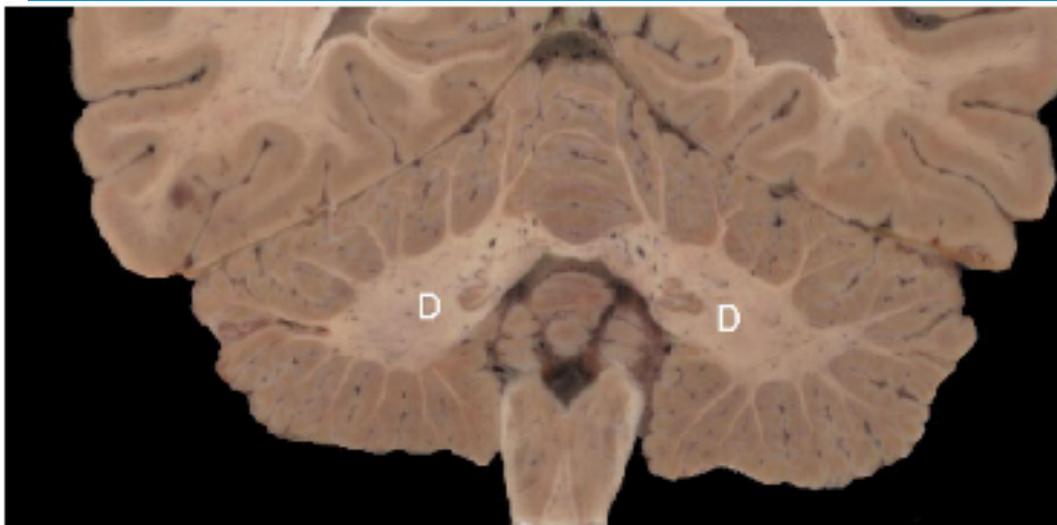
corrélation dyschronie / codes

	Jamais	Rarement	Parfois	Souvent	Très souvent
1- Il (Elle) se souvient difficilement des jours / mois / année que nous sommes.					
2- Il (Elle) confond les moments de la journée matin / après-midi / soirée.					
3- Un événement qui est survenu le matin, il (elle) peut le placer la veille.					
4- Pour un événement qui est survenu il y a quelques jours, il (elle) peut dire : "il y a très longtemps".					
5- Il lui est difficile de comprendre les relations existantes entre les membres de la famille : grands-parents, tantes, neveux, beau-frère.					
6- Il (Elle) a du mal à comprendre les notions de hier, demain ou après-demain.					
7- Il (Elle) a des difficultés à lier l'heure sur un cadran.					
8- Il (Elle) se trompe lorsque il (elle) doit évaluer la durée d'un film, la durée d'une activité, voire même la durée d'une nuit de sommeil.					
9- Vous avez besoin de lui donner des indices pour qu'il (elle) se repère dans une semaine (lundi : école ; mercredi : activités extra-scolaires ; dimanche : repos ...).					



Le cervelet : un organe aux fonctions multiples et émergentes

- motricité, coordination, posture
- Modulateur des apprentissages procéduraux et des automatismes (sensori-moteurs et cognitifs)
- Pace-maker des structures sus-jacentes? Fonction de « timing »



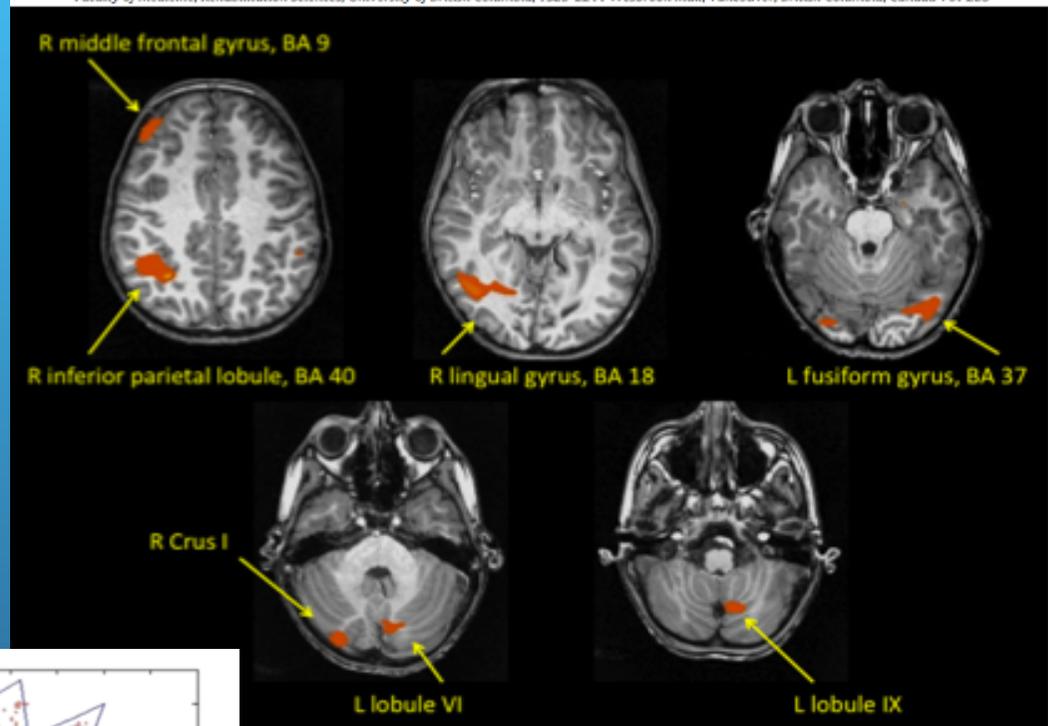
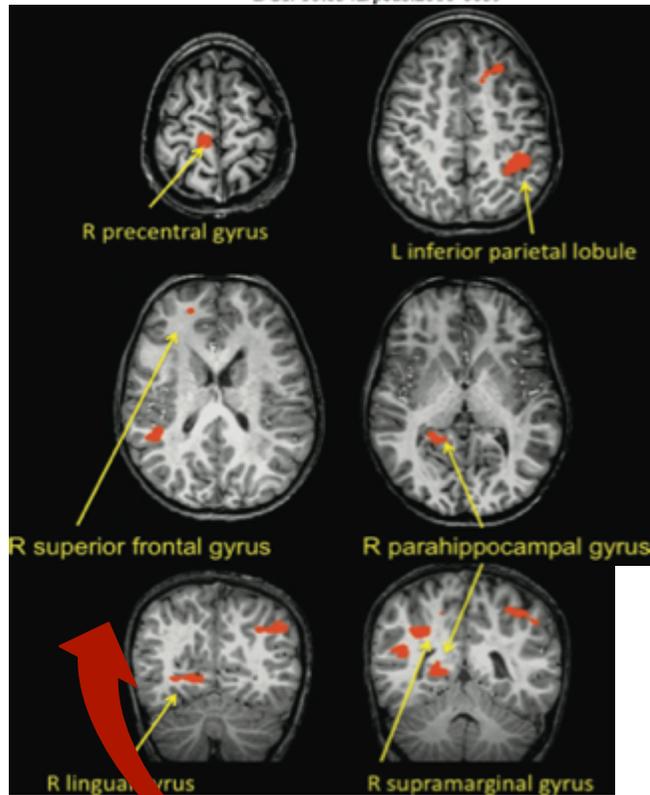
Brain activation associated with motor skill practice in children with developmental coordination disorder: an fMRI study

Jill G. Zwicker^{a,*}, Cheryl Missiuna^b, Susan R. Harris^c, Lara A. Boyd^c

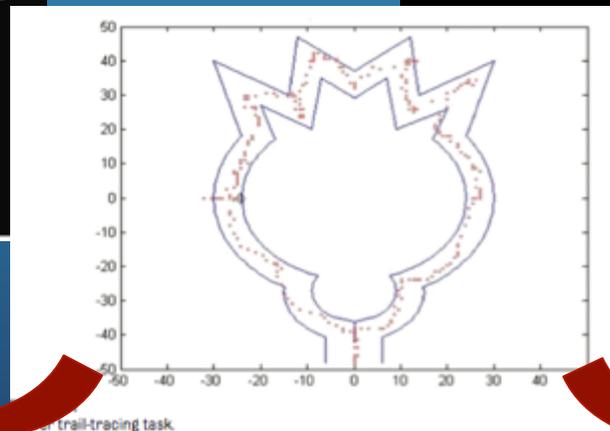
^a Faculty of Medicine, Rehabilitation Sciences, University of British Columbia, T325-2211 Wesbrook Mall, Vancouver, British Columbia, Canada V6T 2B5

Brain Activation of Children With Developmental Coordination Disorder is Different Than Peers

Jill G. Zwicker, Cheryl Missiuna, Susan R. Harris and Lara A. Boyd
Pediatrics 2010;126:e678; originally published online August 16, 2010;
DOI: 10.1542/peds.2010-0059

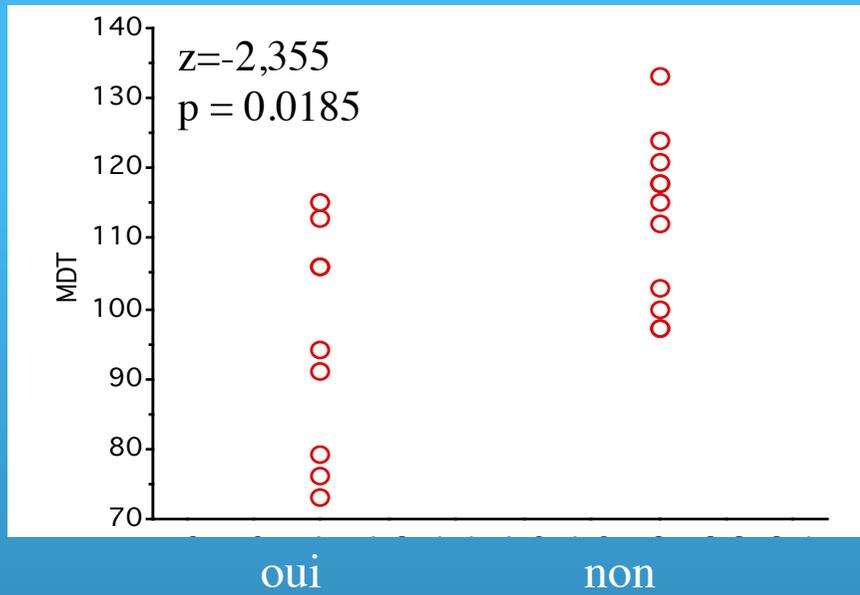


Tracé contours
avec joystick

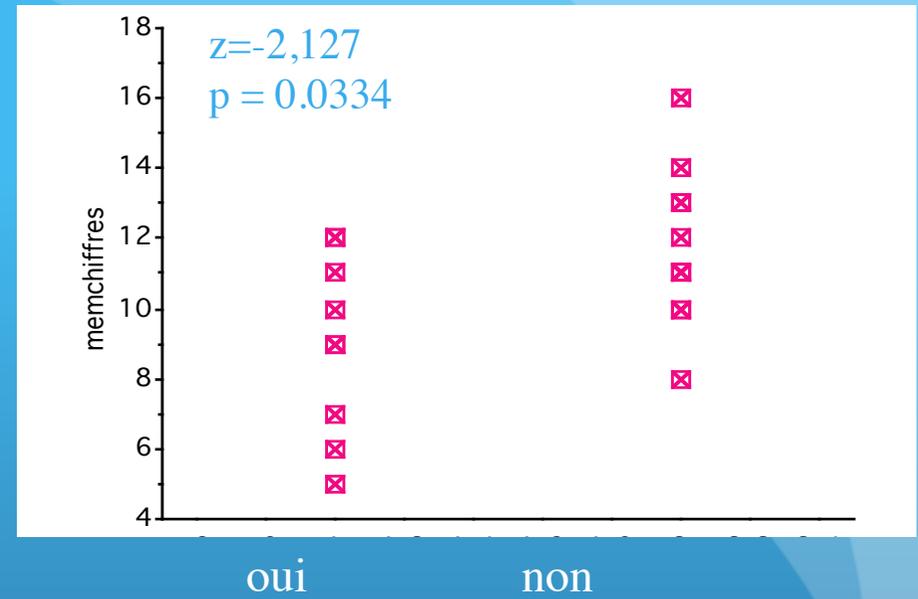


Apprentissage
procédural

MDT

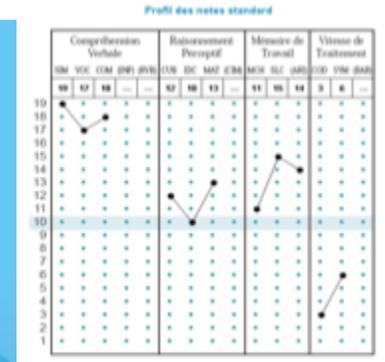


mem chiffres

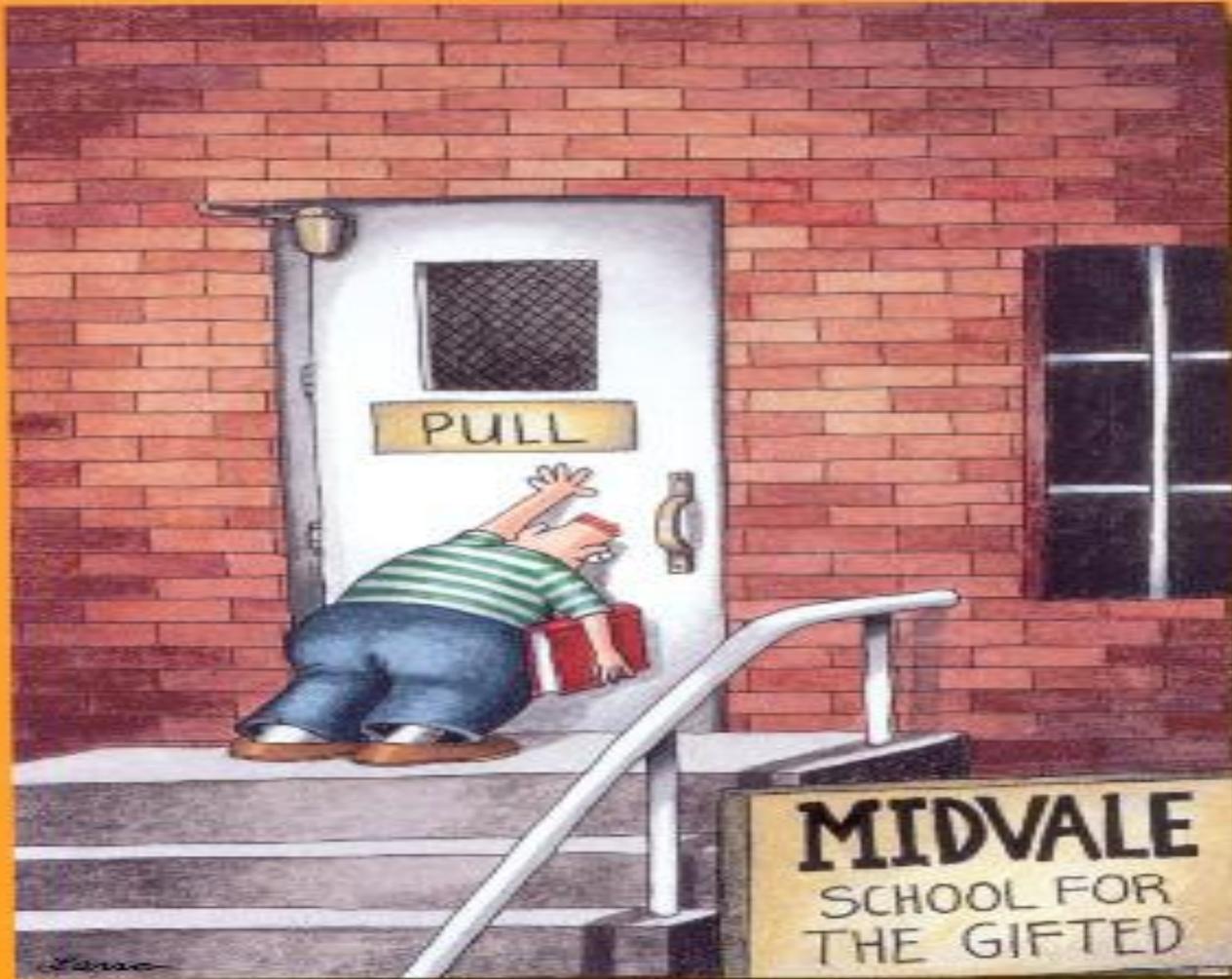


problèmes de lecture au CP

En résumé (1)



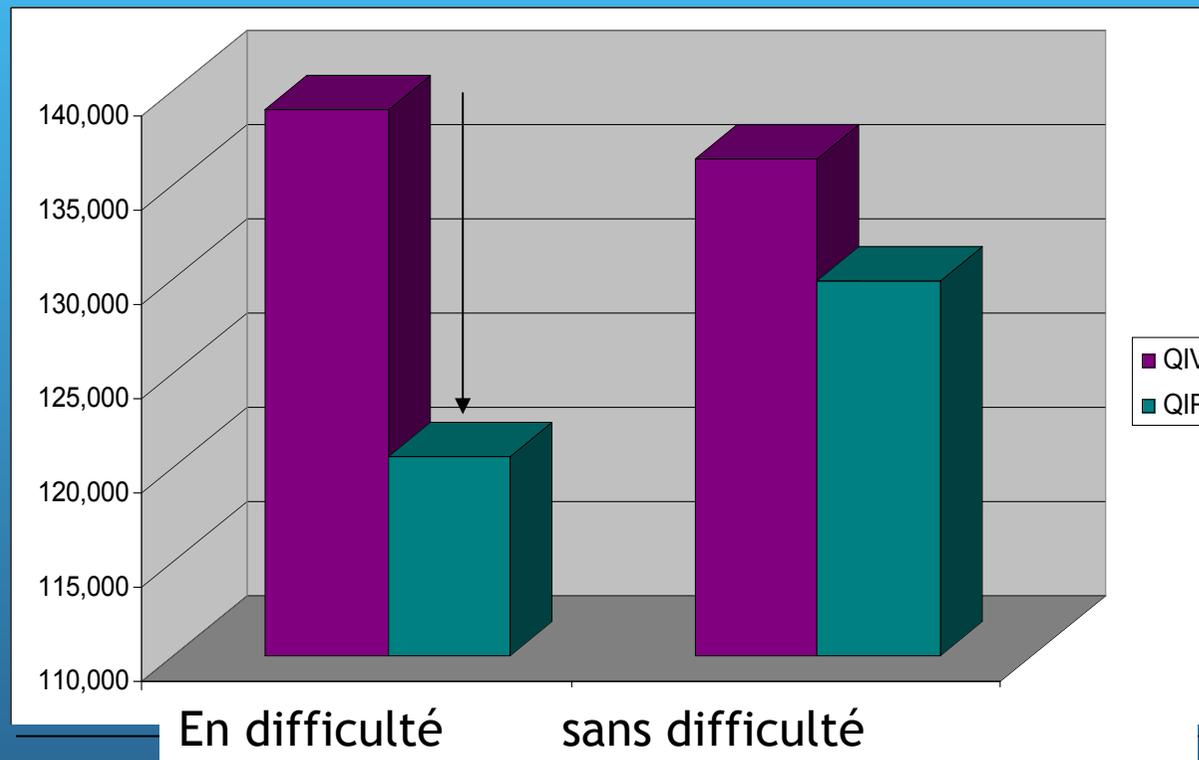
- Le profil des enfants à haut potentiel en difficulté, qu'ils aient ou non connu des difficultés d'acquisition de la lecture, est différent de celui de la majorité des dyslexiques
- Il est caractérisé dans la grande majorité des cas par un écart moyen de plus de 20 points en faveur de l'indice de compréhension verbale, suggérant un excellent raisonnement verbal et un profil relatif de dyspraxie ou de "syndrome hémisphérique droit", incluant souvent des difficultés d'acquisition des coordinations, des notions spatiales et des notions temporelles
- Plus de la moitié des enfants ont souffert de difficultés de lecture.
- Les enfants en difficulté de lecture avaient tendance à souffrir d'une limitation de la mémoire de travail, suggérant un trouble attentionnel associé.
- Chez un quart des enfants, les performances en calcul étaient en-dessous du niveau escompté



Etude du type de dyslexie

- 10 EIP sans troubles d'apprentissage
 - âge : 9;3 a. à 13;9 a,
 - scolarisés entre 6e et 4e;
 - 9 G, 1F.
- 9 EIP avec troubles d'apprentissage
 - âge : 9;4 a. à 13;10 a,
 - scolarisés entre 6e et 3e;
 - 7 G, 2F.
- Analyse du langage oral : TLOCC
- Analyse du langage écrit
 - LMC-R
 - Alouette
 - Odédys
 - Vol du PC
- Épreuve spécifique visuo-attentionnelle : report global de S. Valdois

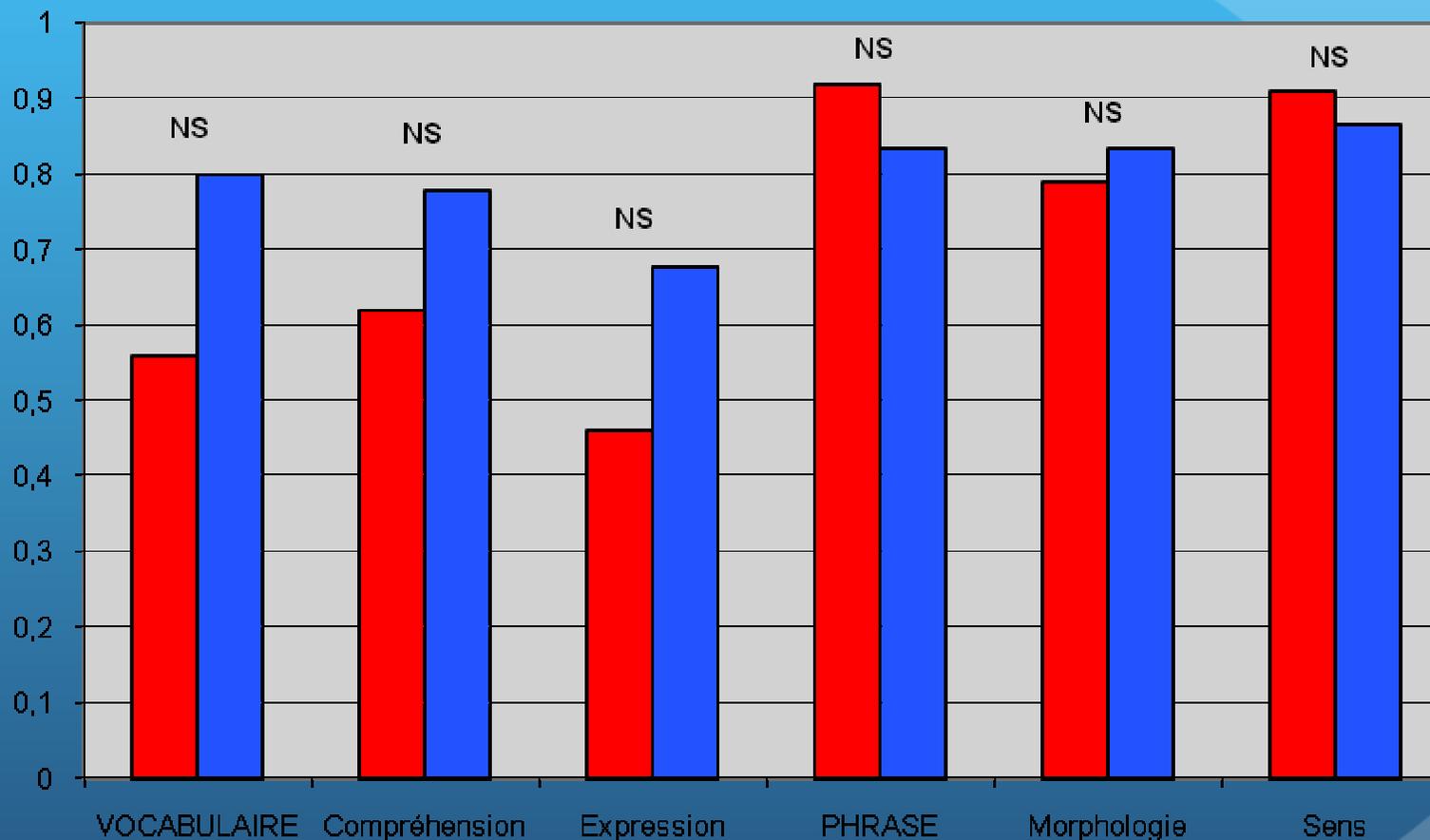
Profil du QI de chaque groupe



QI verbal > QI non verbal

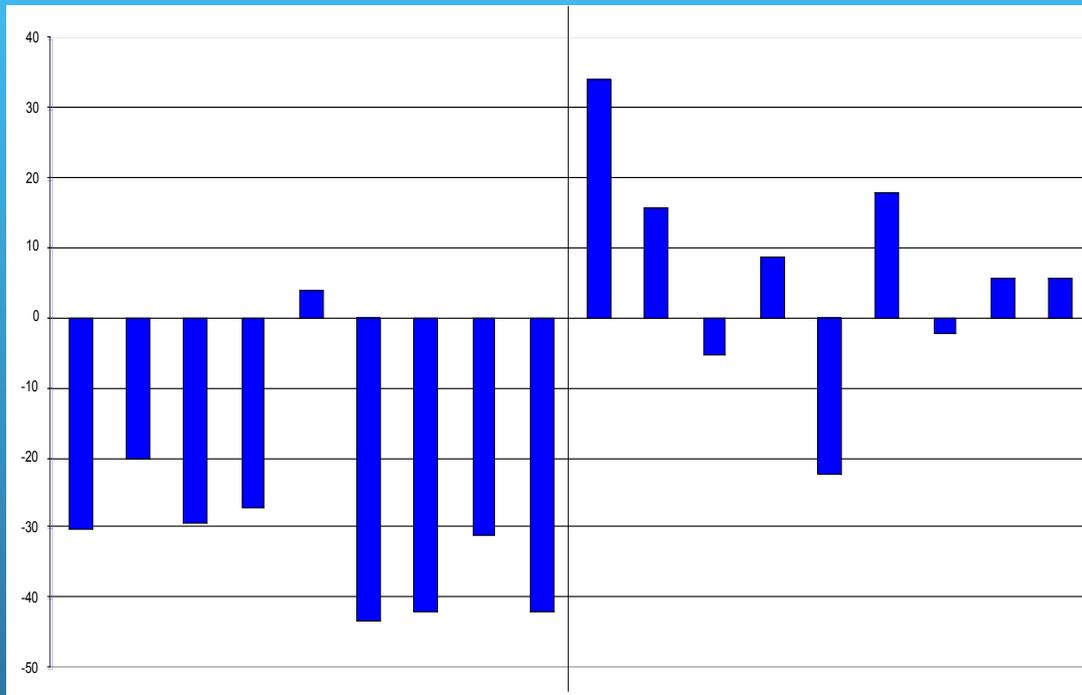
Ecart plus important pour le groupe d' EIP présentant des troubles des apprentissages

Analyse du langage oral



- EIP avec tr. d'apprentissage
- EIP sans tr. d'apprentissage

Âge de lecture (Alouette)



Diff. Apprent.

- 29 mois

→ 8 dyslexies

Sans Diff. Apprent.

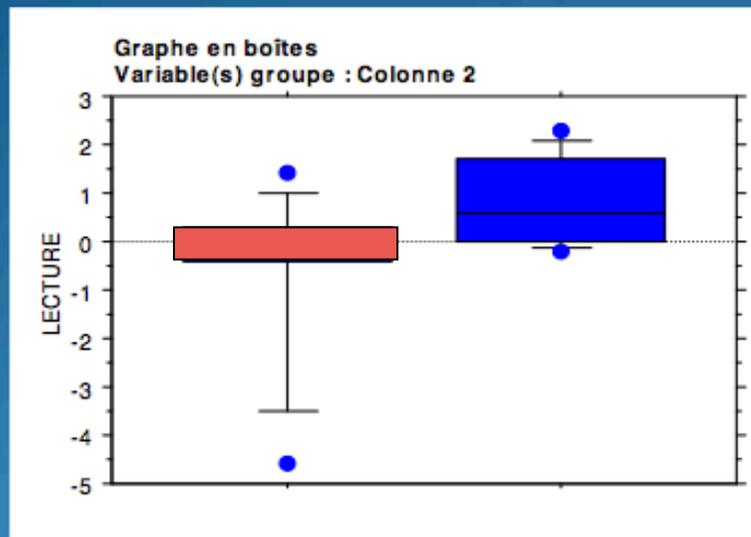
+ 7 mois

→ 1 dyslexie

Groupe avec difficultés :
tous dysl. sauf 1

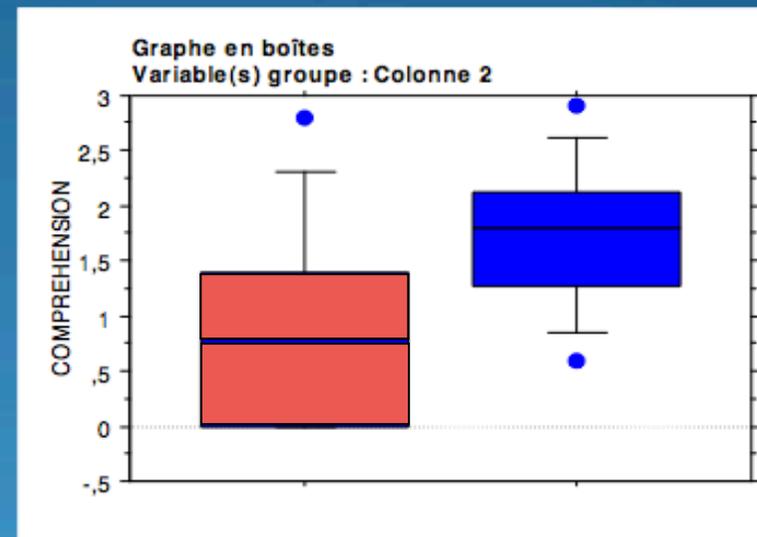
Groupe sans difficulté :
tous non-dysl. sauf 1

Lecture de texte



Niveau autour de la moyenne

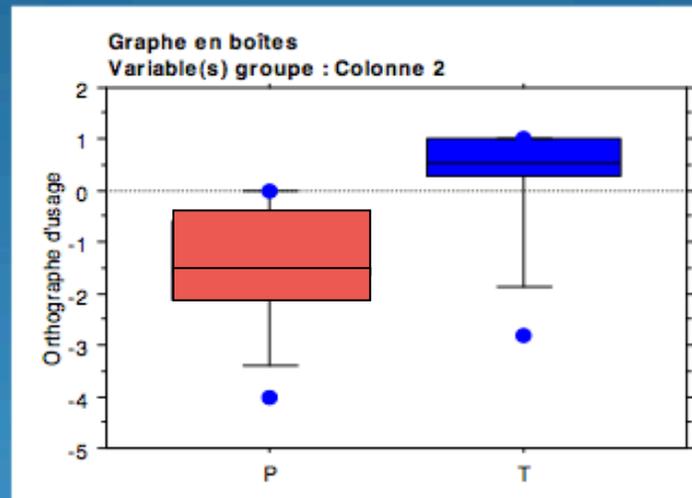
Compréhension de texte



Bonne compréhension écrite

→ Stratégies de compensation

Orthographe d'usage



Niveau pathologique pour 7 EIP sur 10

→ 7 dysorthographies de surface

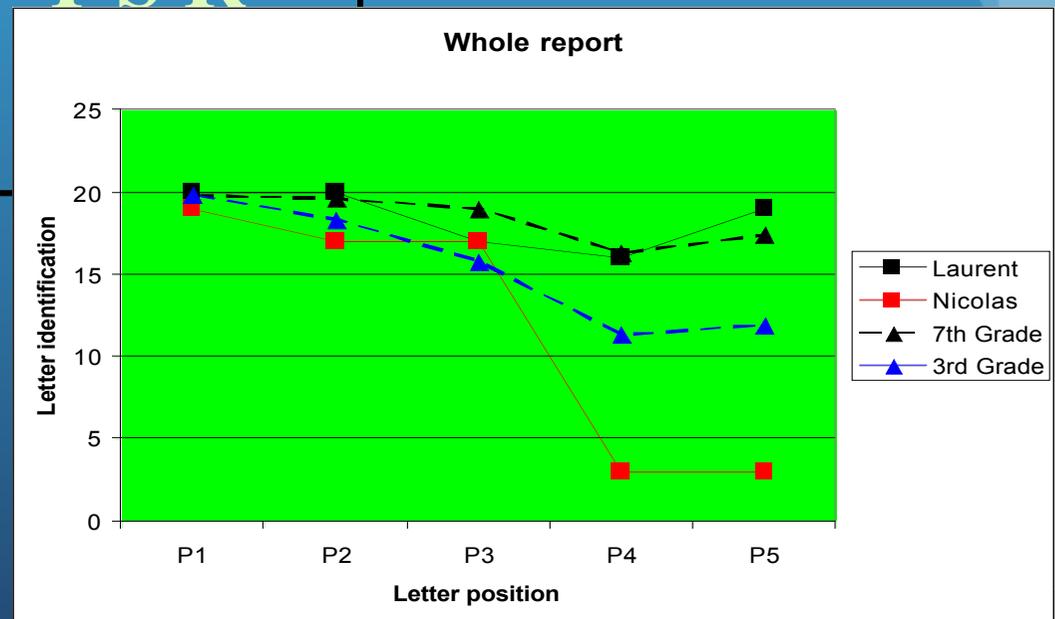
Stock lexical orthographique déficitaire (ex : « assez » → « assé »)

Epreuve visuo-attentionnelle (S. Valdois)

Report Global

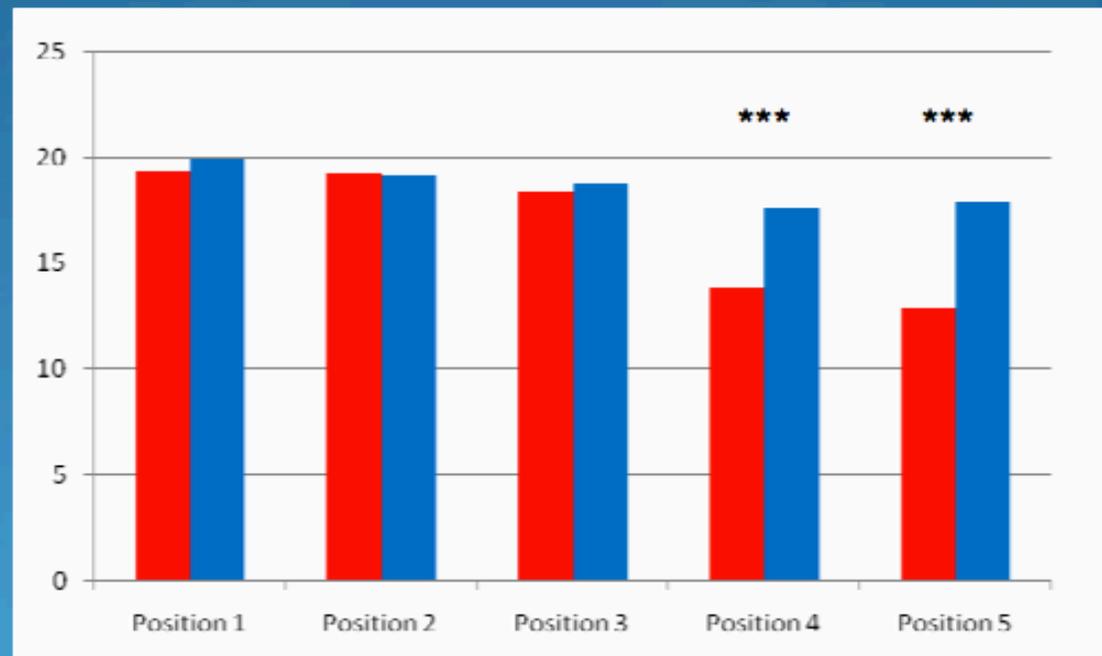
A V T S R

Réponse



➤ Compétences visuo-attentionnelles

Report Global (S.Valdois)



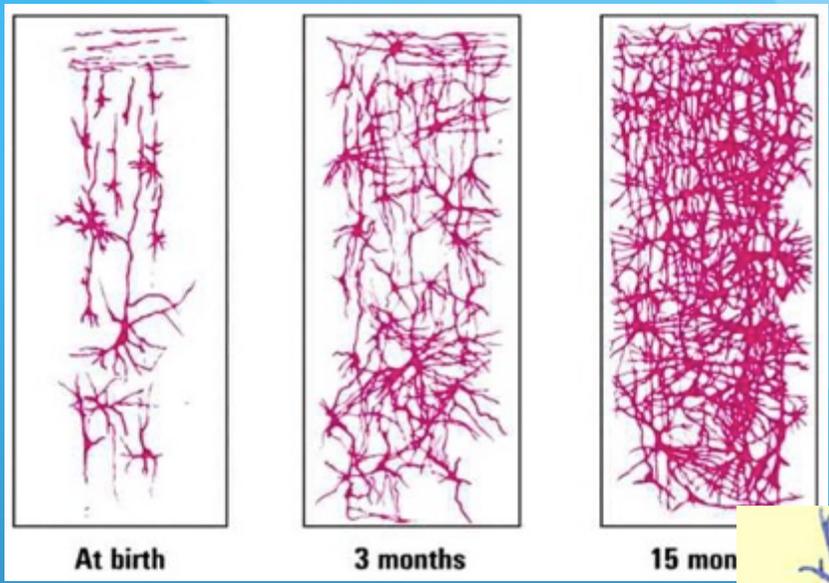
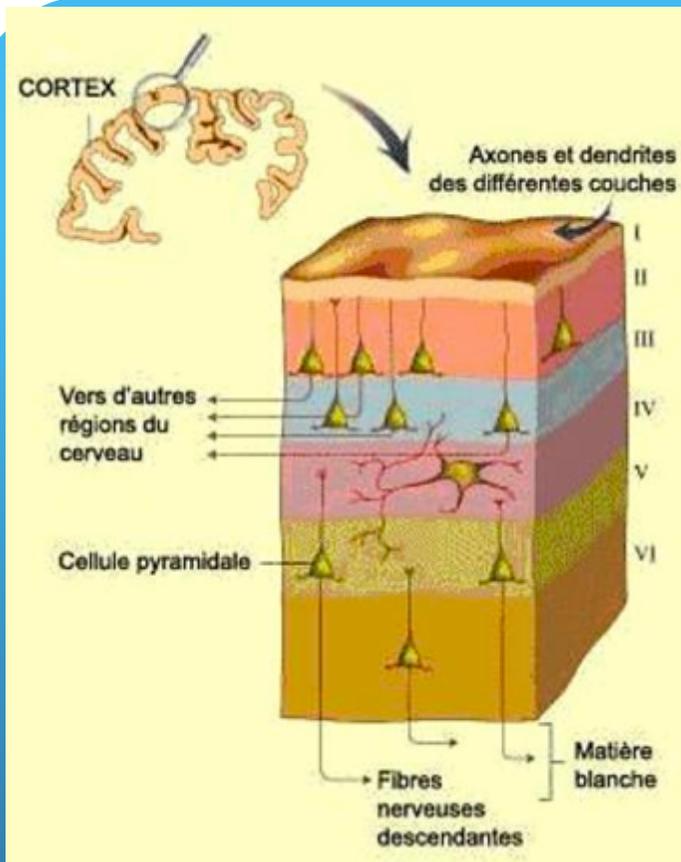
*** $p = 0.003$

Effet positionnel → troubles visuo-attentionnels

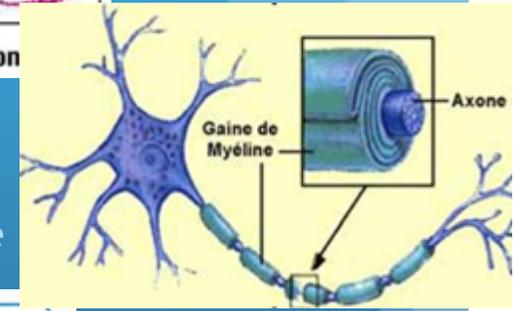
- EIP avec tr. d'apprentissage
- EIP sans tr. d'apprentissage

Un bref panorama des études récentes cerveau/précocité

- Avant l'avènement de l'imagerie fonctionnelle (~<1995)
 - Notions sur la taille du cerveau, du cortex, de l'hippocampe..., et leur corrélation avec le QI
 - Notions assez générales sur des particularités de la transmission de l'influx électrique (EEG, potentiels évoqués)
- Depuis l'apparition de l'imagerie fonctionnelle (PET, IRMf++)
 - Nombreuses études comparant l'activation cérébrale lors de tâche à fort ou faible « poids facteur g » (g-loaded)
 - Quelques études comparant précisément précoces et témoins à intelligence standard
 - Très rares études consacrées aux précoces avec difficultés
- Apport plus prometteur de l'imagerie morphologique
 - études transversales de la maturation du cortex
 - Études de connectivité entre régions distantes

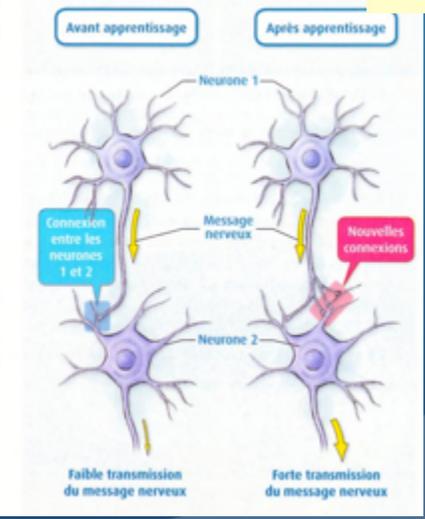
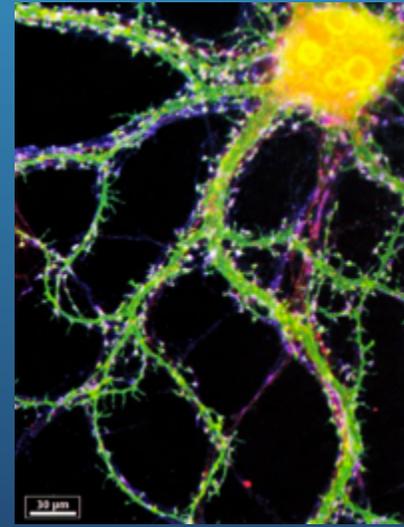


Prolifération dendritique :
atteint son maximum vers 2 ans
+ gaine de myéline



Cortex cérébral : neurones,
axones, dendrites, synapses

Apprentissage : synapses se
créent, s'éliminent, se modifient

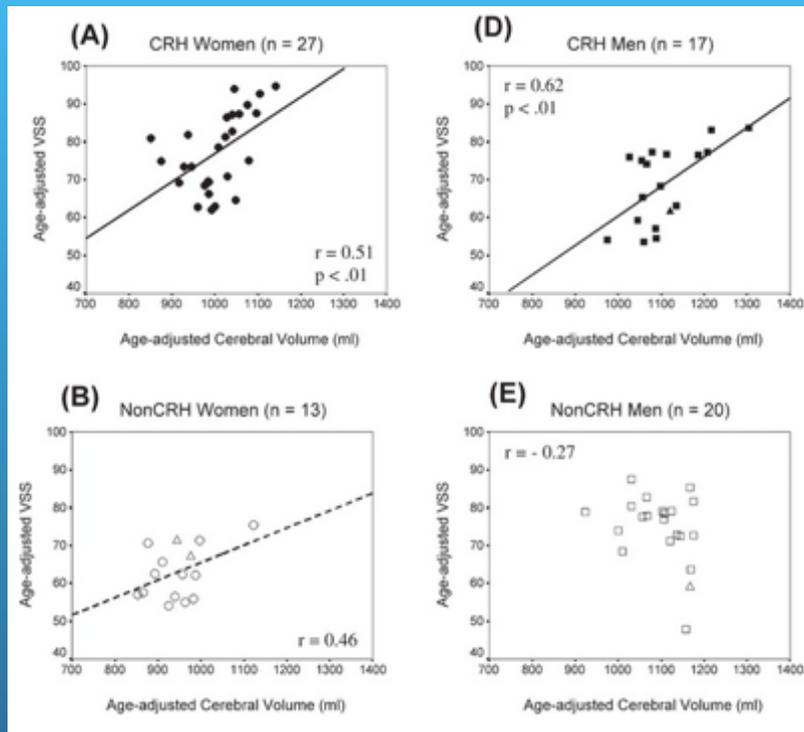


Intelligence et volume cérébral : quelles relations?

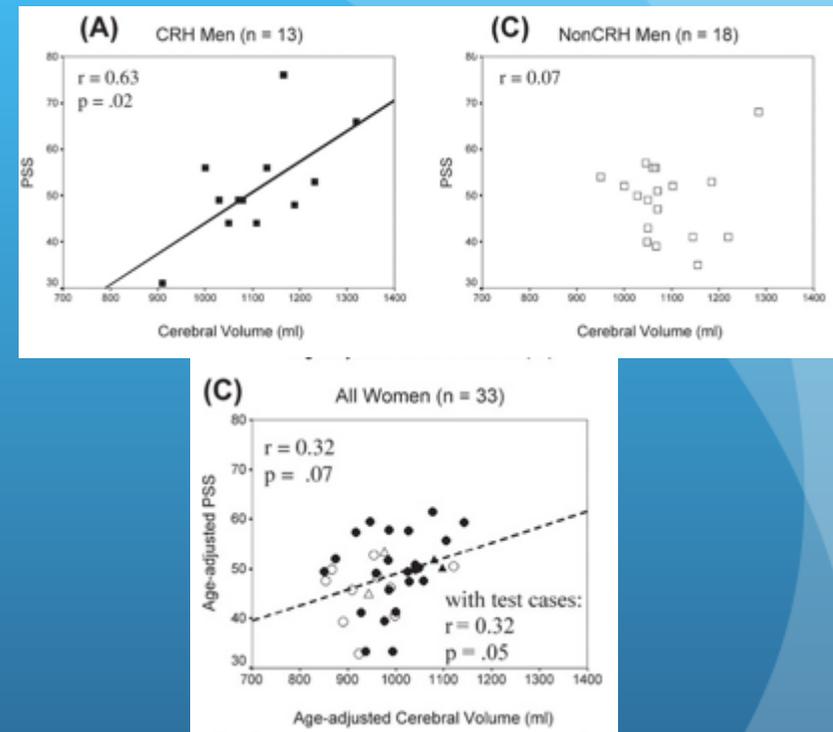
- Une méta-analyse de 37 études avec un nombre total de 1530 participants. Conclusion : « Ce rapport résout définitivement le débat ouvert il y a 169 ans : il est clair que l'intelligence et le volume cérébral sont positivement corrélés».
- Plus précisément, les résultats de cette étude étaient triples :
 - 1) la corrélation moyenne est de 0,33 (ce qui est relativement faible) ;
 - 2) cette corrélation est plus forte pour les individus de sexe féminin (0,40) ; et
 - 3) elle ne change pas avec l'âge.

McDaniel MA. Big-brained people are smarter: a meta-analysis of the relationship between in vivo brain volume and intelligence. *Intelligence*. 2005;33:337-346.

Intelligence et volume cérébral : effet de la latéralisation hémisphérique



Verbal IQ vs. total cerebral volume



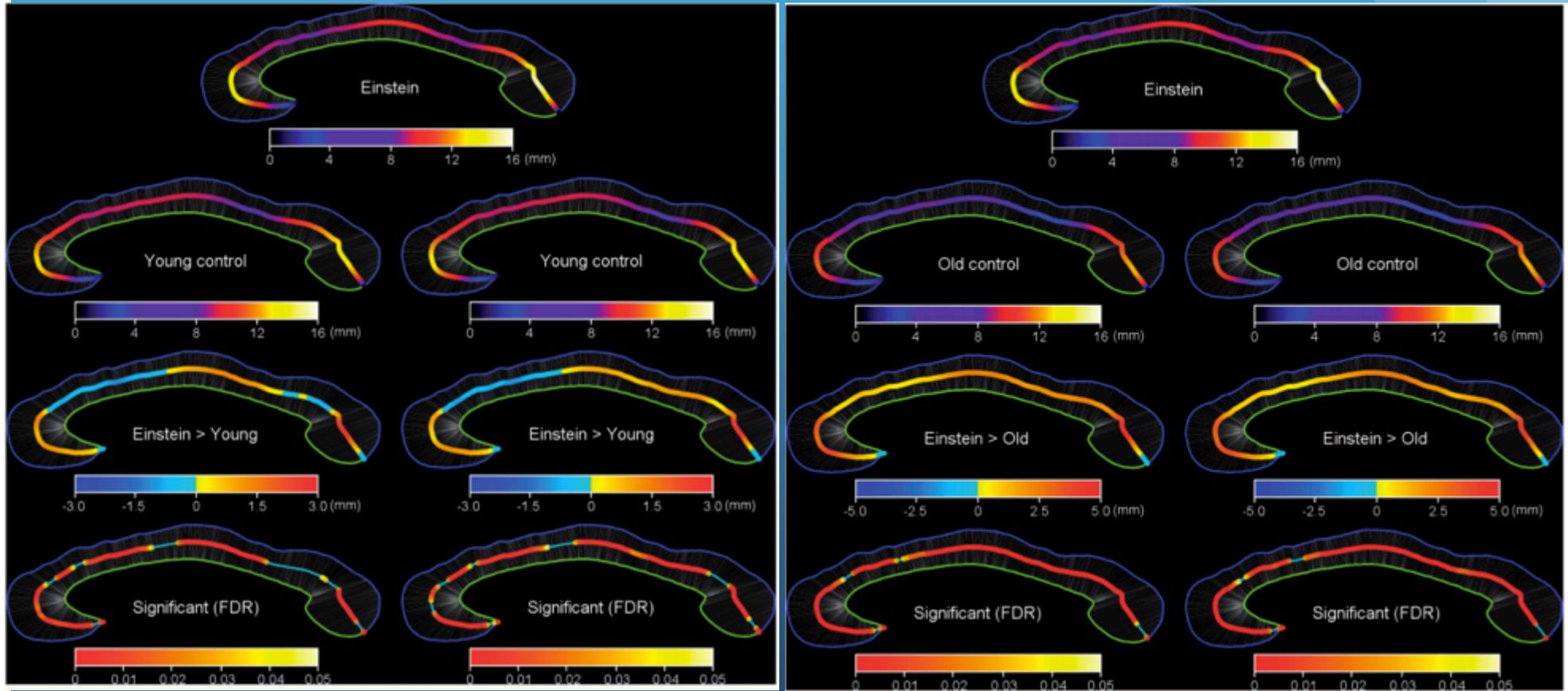
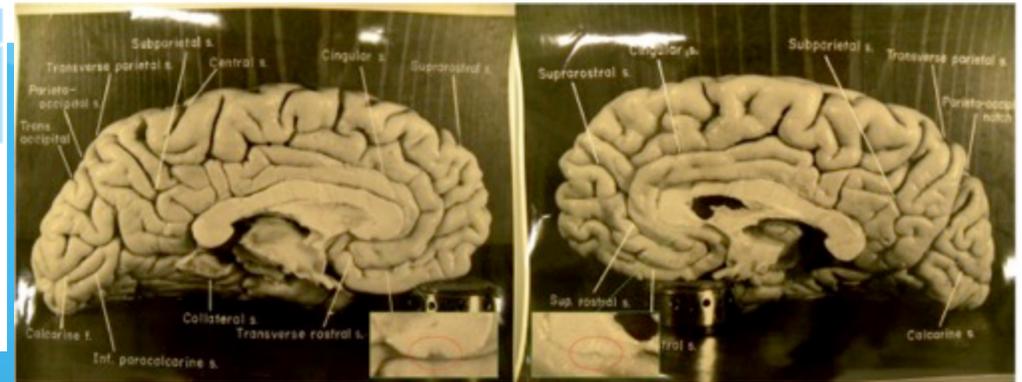
Perform. IQ vs. total cerebral volume

S. F. Witelson, H. Beresh, D. L. Kigar. (2006). Intelligence and brain size in 100 postmortem brains: sex, lateralization and age factors. [Brain](#). 129(Pt 2):386-98.

LETTER TO THE EDITOR

The corpus callosum of Albert Einstein's brain: another clue to his high intelligence?

Weiwei Men,¹ Dean Falk,^{2,3} Tao Sun,⁴ Weibo Chen,¹ Jianqi Li,¹ Dazhi Yin,¹ Lili Zang¹ and Mingxia Fan¹



Neuromythology of Einstein's brain



Terence Hines

Psychology Department, Pace University, Pleasantville, NY, United States
Neurology Department, New York Medical College, Valhalla, NY, United States

ARTICLE INFO

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Cognition

ABSTRACT

The idea that the brain of the great physicist Albert Einstein is different from "average" brains in both cellular structure and external shape is widespread. This belief is based on several studies examining Einstein's brain both histologically and morphologically. This paper reviews these studies and finds them wanting. Their results do not, in fact, provide support for the claim that the structure of Einstein's brain reflects his intellectual abilities.

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frontiers in
EVOLUTIONARY NEUROSCIENCE

ORIGINAL RESEARCH ARTICLE

published: 04 May 2009
doi: 10.3389/neuro.18.003.2009



New information about Albert Einstein's brain

Dean Falk*

Department of Anthropology, Florida State University, Tallahassee, FL, USA

doi:10.1093/brain/aws295

Brain 2013; 136: 1304–1327 | 1304

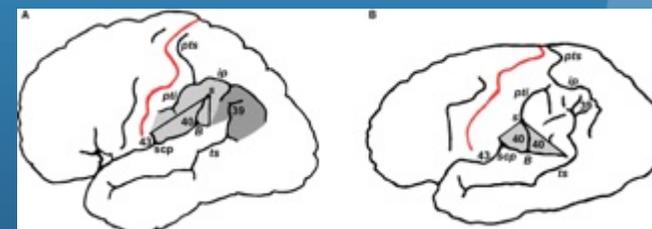
BRAIN

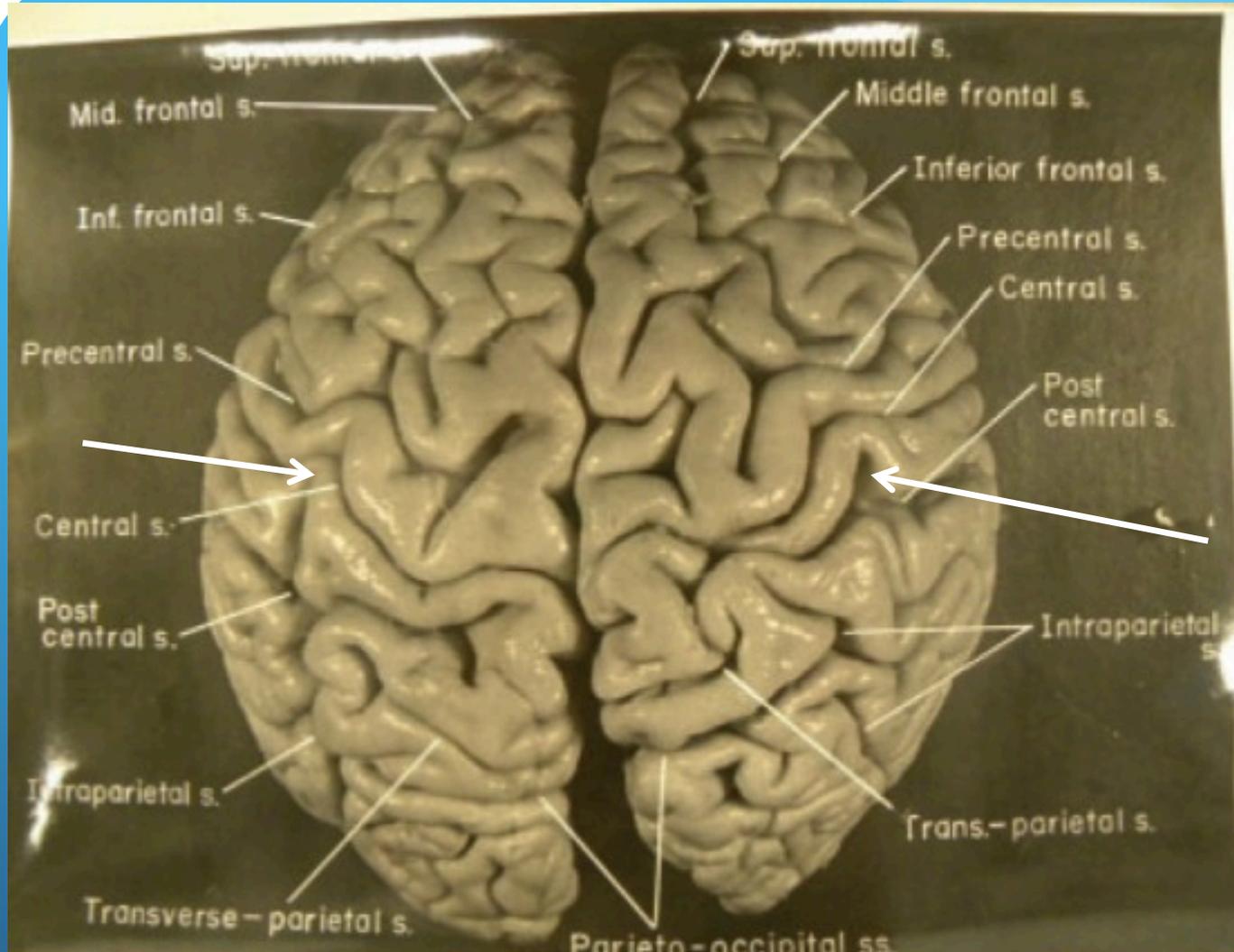
A JOURNAL OF NEUROLOGY

OCCASIONAL PAPER

The cerebral cortex of Albert Einstein: a description and preliminary analysis of unpublished photographs

Dean Falk,^{1,2} Frederick E. Lepore^{3,4} and Adrienne Noe⁵

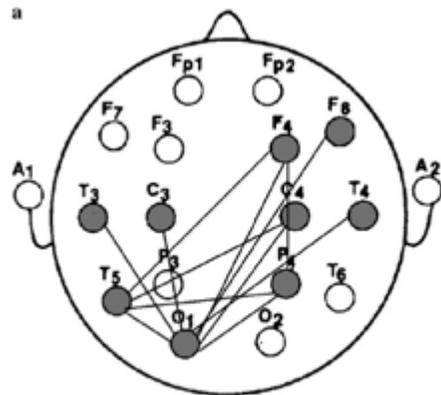




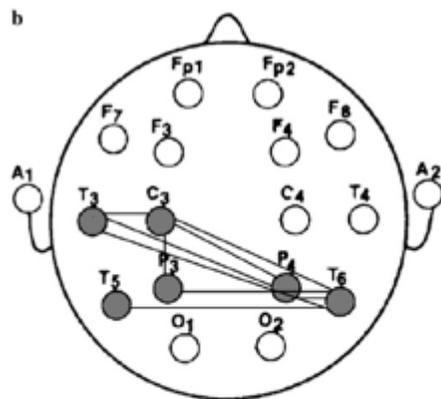
Differences in brain information transmission between gifted and normal children during scientific hypothesis generation

Seung-Hyun Jin ^a, Yong-Ju Kwon ^{b,*}, Jin-Su Jeong ^b, Suk-Won Kwon ^b, Dong-Hoon Shin ^b

control



gifted



Les HPI utilisent préférentiellement les régions postérieures de leur cerveau, et distribuent leurs ressources cognitives plus efficacement

Fig. 1. *t*-map describing all the pairs where higher A-CMI values (paired *t*-test, $P < .05$) are observed in hypothesis generation condition: (a) the normal children and (b) the gifted children, as compared to A-CMI values at a resting state. The straight line indicates the bi-directionally increased A-CMI values.

Après placement des électrodes sur le scalp, les enfants devaient lire une série de questions puis formuler une explication causale à partir des questions évoquées. Les résultats ont été obtenus après une analyse multivariée des A-CMI (averaged cross mutual information): "In contrast to normal children, gifted children showed increased A-CMI values between the left temporal and central, between the left temporal and parietal, and between the left central and parietal locations while generating a hypothesis. These results suggested that gifted children more efficiently distribute the cognitive resources essential to cope with hypothesis generation."

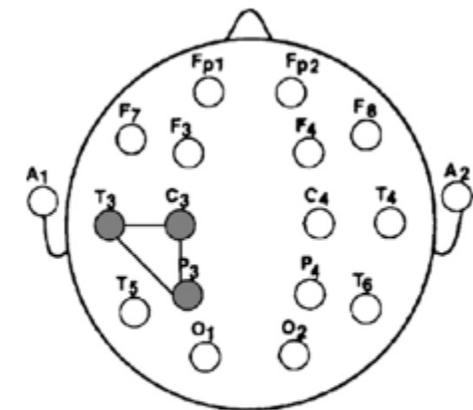


Fig. 2. *t*-map describing all the pairs where the gifted children have higher A-CMI values (unpaired *t*-test, $P < .05$) than the normal children. The straight line indicates the bi-directionally increased A-CMI values.

DECISION LEXICALE

AVION

Mot

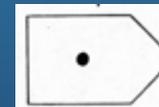
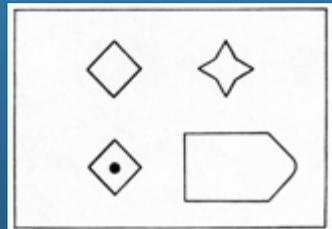
NOAGE

Pseudo-mot

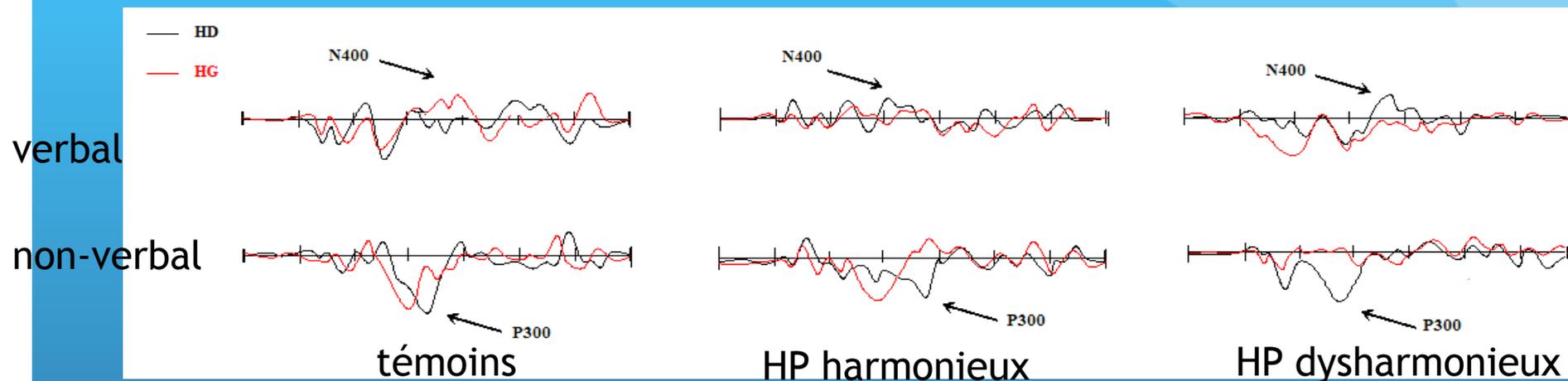
WXPT

Non-mot

COMPLEMENT D'UNE MATRICE



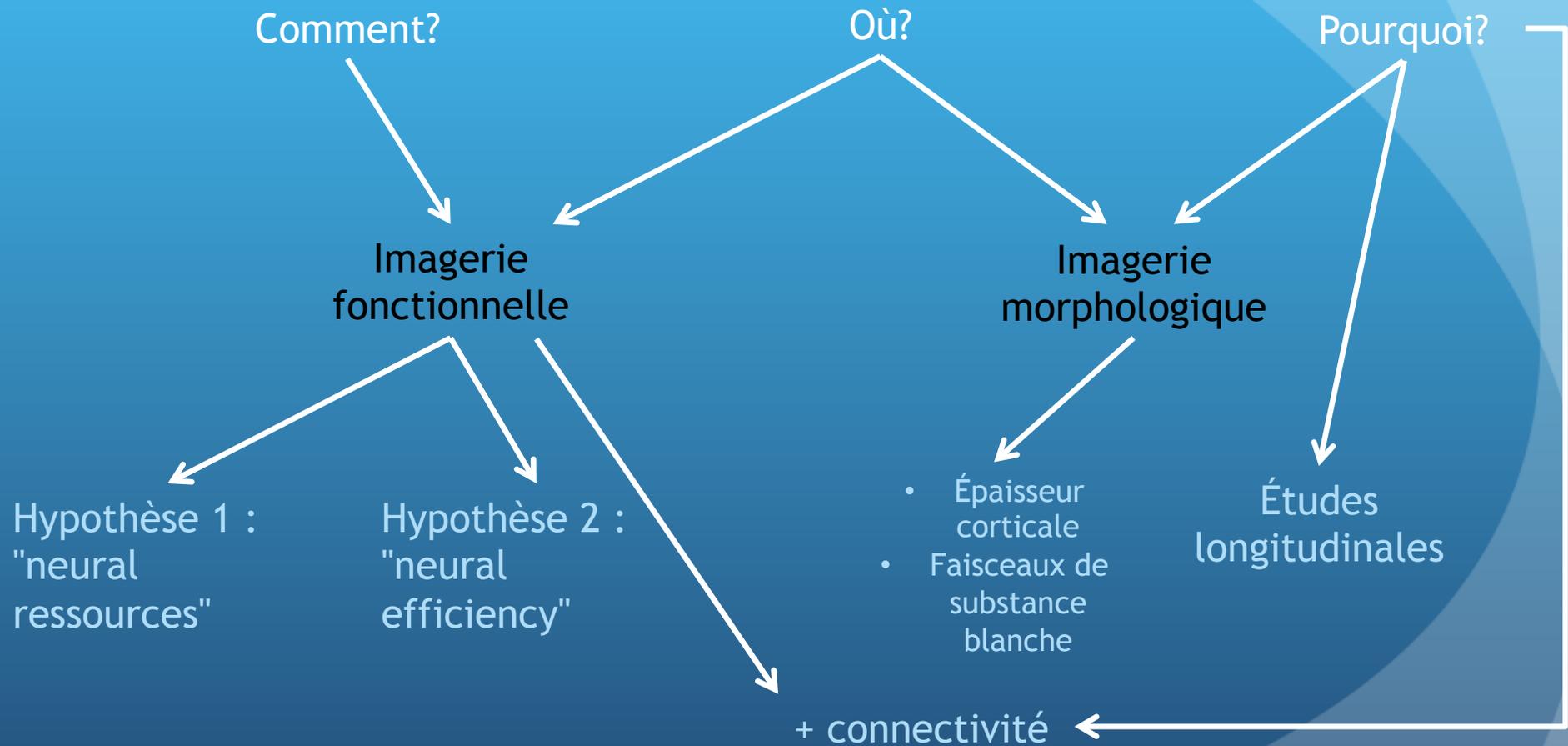
Exemples de PE enregistrés lors des tâches de décision lexicale et de complèment de matrice chez des enfants (contrôle, intellectuellement précoces harmonieux et dysharmonieux)



les enfants ayant une importante différence entre leurs performances verbales et pragmatiques dont témoigne le profil dysharmonieux du Q.I. auraient tendance à surengager l' hémisphère cérébral droit aux dépens du gauche quel que soit le type de tâche. Les enfants ayant un profil harmonieux de performances cognitives auraient, quant à eux, tendance à engager leurs deux hémisphères à la fois dans les tâches verbales et non verbales.

Magnié M.N., Caro C., Faure F. (2003). Hemispheric specialisation in giftedness: psychometric, behavioral and electrophysiological investigation. Sixth IBRO World Congress of Neuroscience, Prague, Czech Republic, July 10th - 15th, 2003

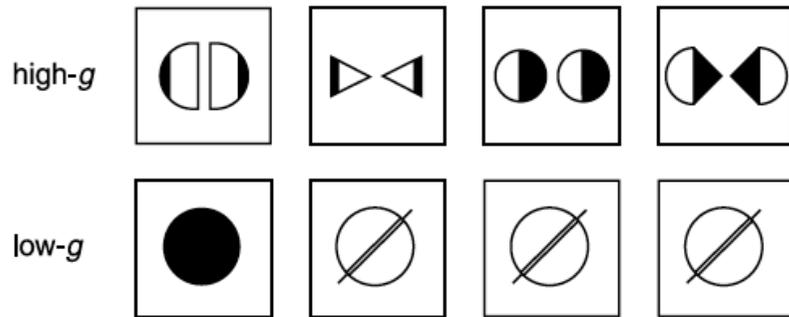
Imagerie cérébrale : questions et hypothèses



A Neural Basis for General Intelligence

John Duncan,^{1*} Rüdiger J. Seitz,² Jonathan Kolodny,¹
 Daniel Bor,¹ Hans Herzog,³ Ayesha Ahmed,¹ Fiona N. Newell,¹
 Hazel Emslie¹

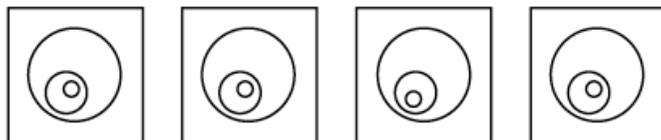
A Spatial



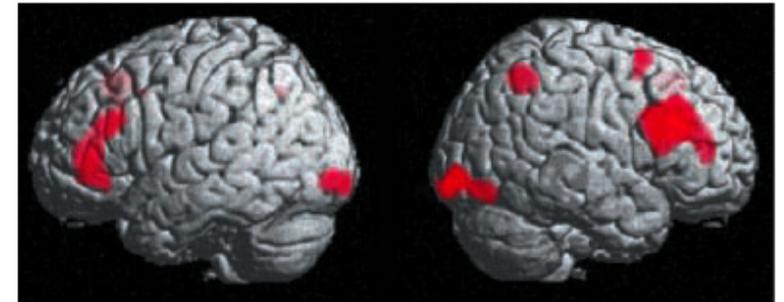
B Verbal

high- <i>g</i>	L H E C	D F I M	T Q N K	H J M Q
low- <i>g</i>	O P Q S	G H I J	L M N O	I J K L

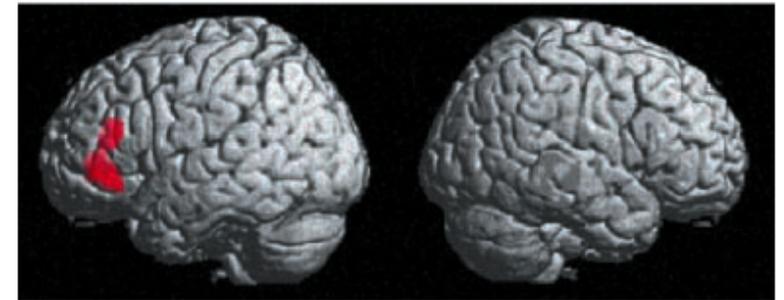
C Circles



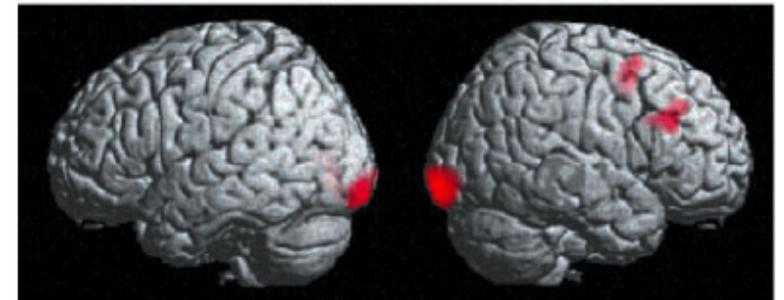
A Spatial



B Verbal



C Circles



Duncan et al. :

"Such results argue strongly against the possibility that high-g tasks are associated with diffuse neural recruitment"

Neural correlates of superior intelligence: Stronger recruitment of posterior parietal cortex

Kun Ho Lee,^{a,*} Yu Yong Choi,^{a,c} Jeremy R. Gray,^b Sun Hee Cho,^c Jeong-Ho Chae,^d Seungheun Lee,^c and Kyungjin Kim^a

Investigation des bases neurales de la douance intellectuelle en comparant

- un groupe d'intelligence supérieure (n = 18, RAPM moy = 33.9 ± 0.8 , >99%)
- un groupe témoin (n = 18, RAPM moy = 22.8 ± 1.6 , 60%) from local high schools in Korea
- age moy = 16.5 ± 0.8).

Acquisition fMRI lors de la réalisation de deux tâches (high and low g-loadings).

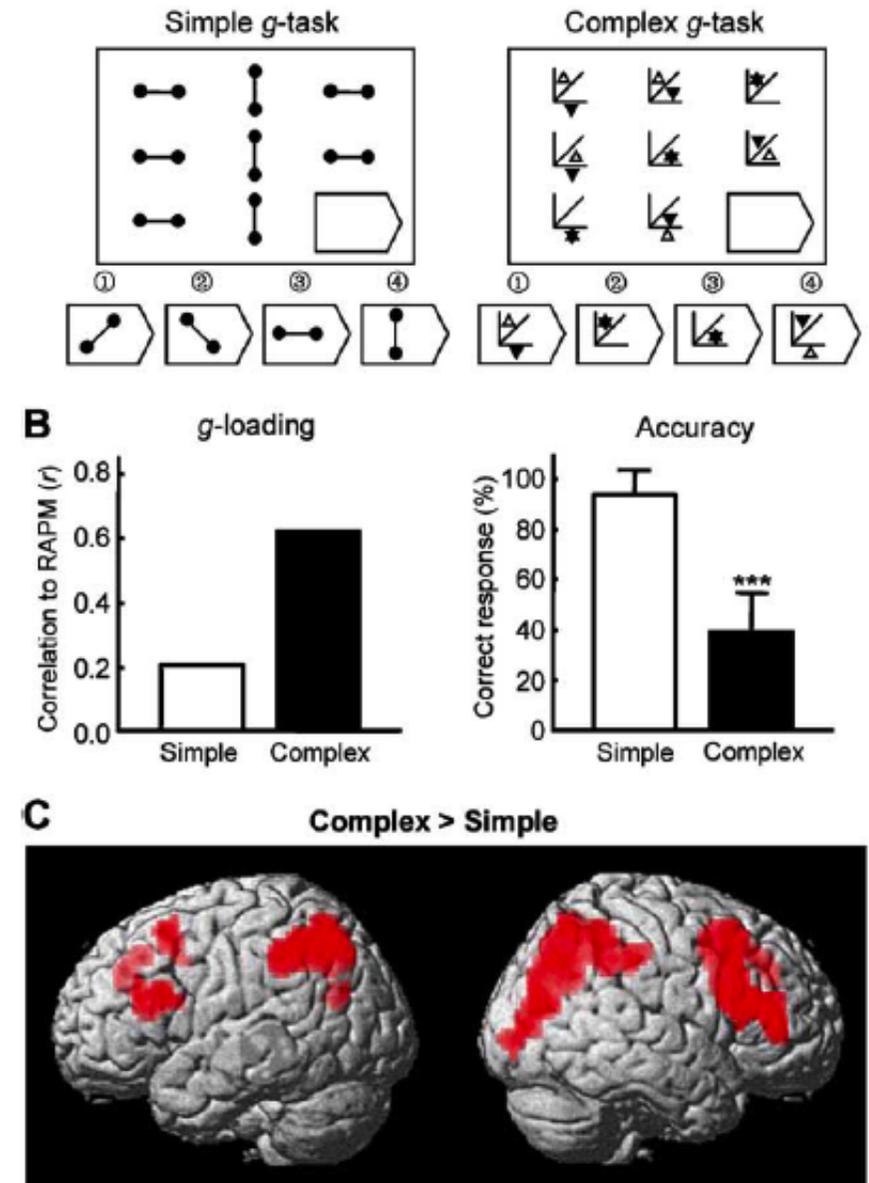
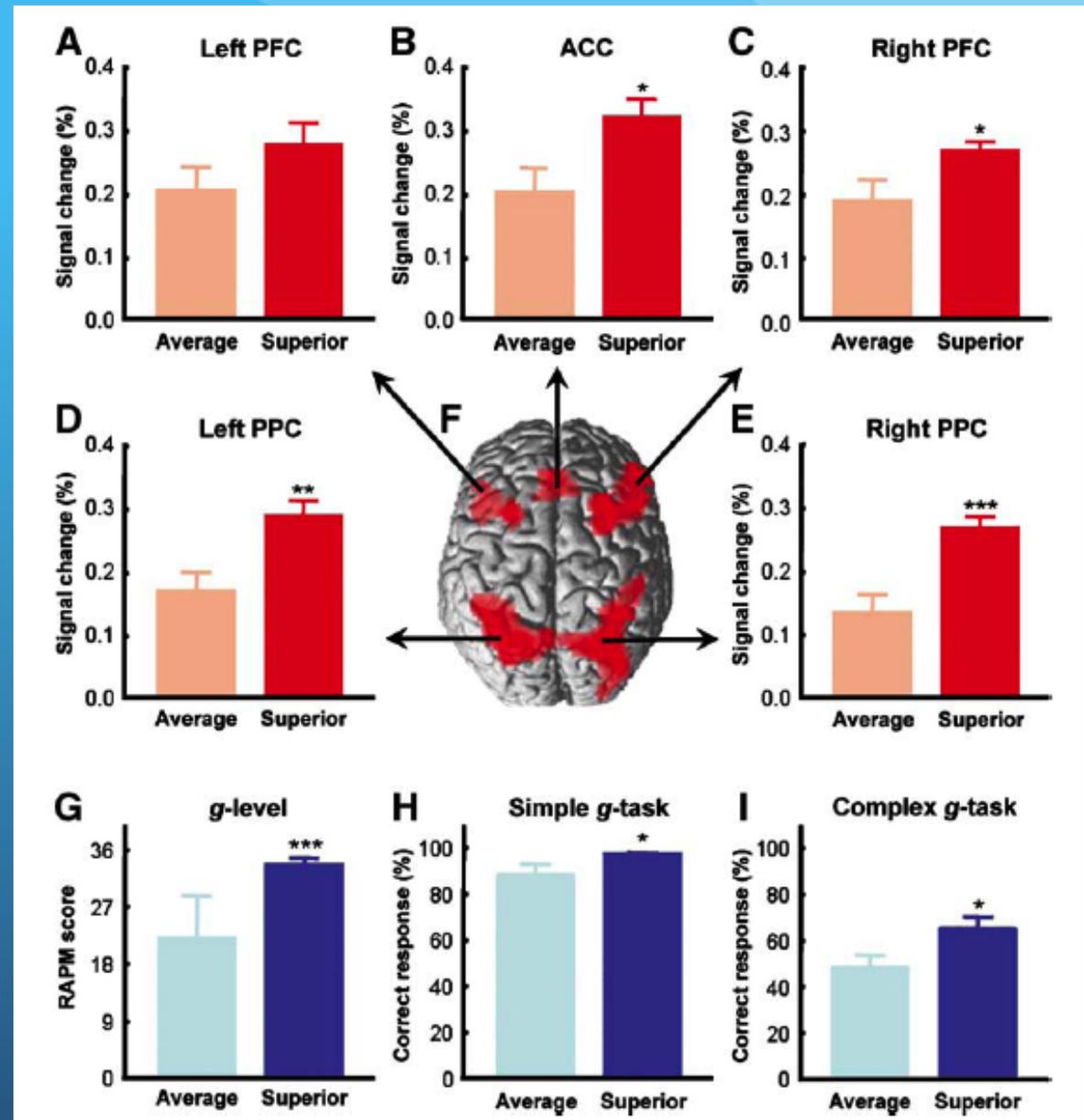
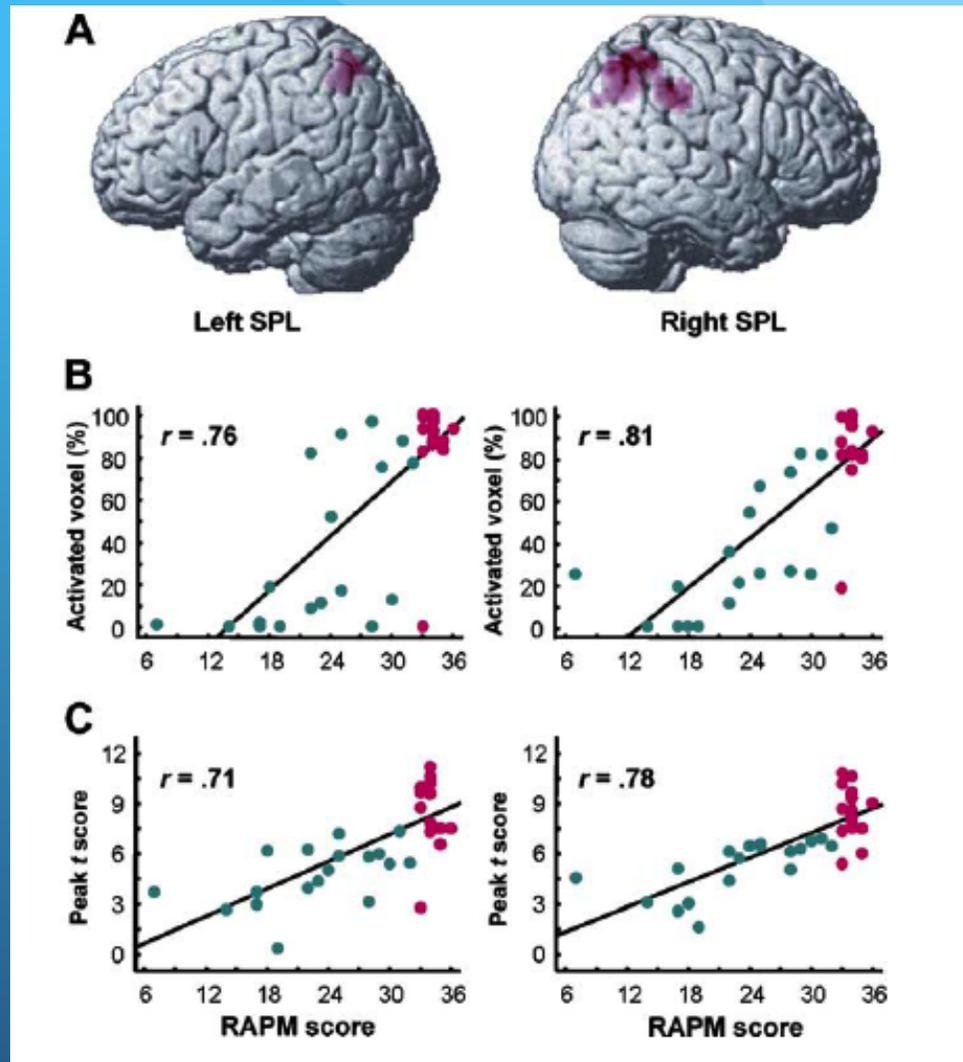


Fig. 1. Behavioral tasks and g-related neural network. (A) Example task

Différences d'activations régionales entre les groupes précoce et 'average'
Surtout significatif dans les deux régions pariétales



g-level-related neural substrates
and correlation of their
activations
with individual differences in g



We reviewed the state-of-the-art based on 37 studies and proposed a specific neuro-anatomical model of intelligence with testable predictions

The Parieto-Frontal Integration Theory (P-FIT) of intelligence: Converging neuroimaging evidence

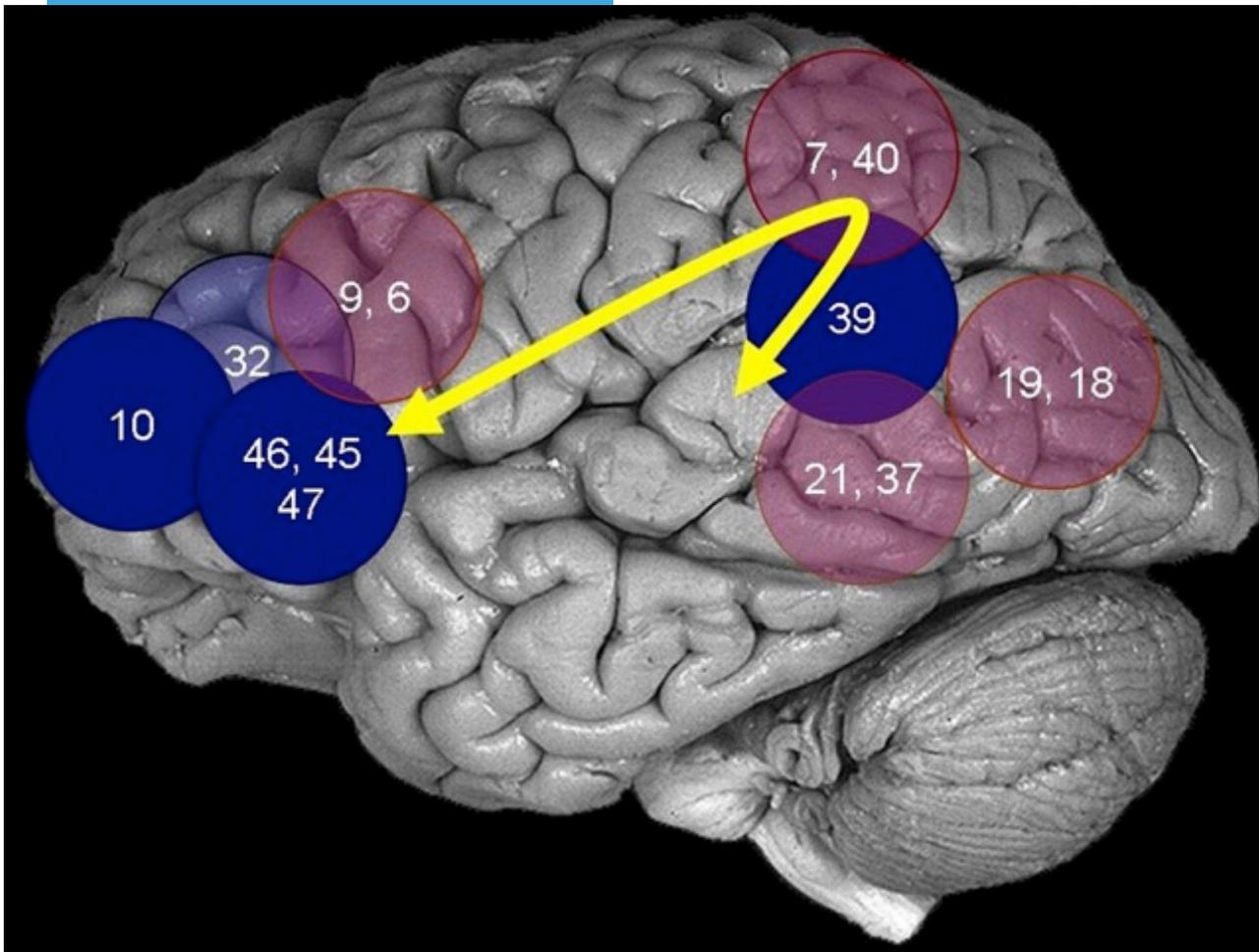


Rex E. Jung

Departments of Neurology and Psychology, Un
The MIND Research Network, Albuquerque, NM
rjung@themindinstitute.org www.themir
www.positiveneuroscience.com

Richard J. Haier

School of Medicine, Med Sc I; C237, University
92697-4475
rjhaier@ucl.edu http://www.uclhs.ucl.edu/pediatrics/faculty/
neurology/haier/haier.html



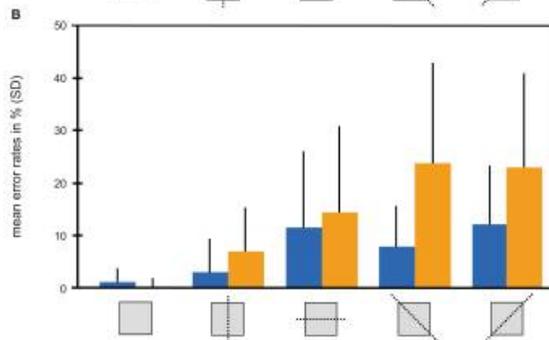
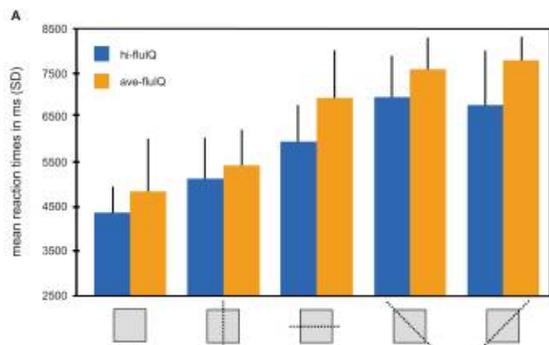
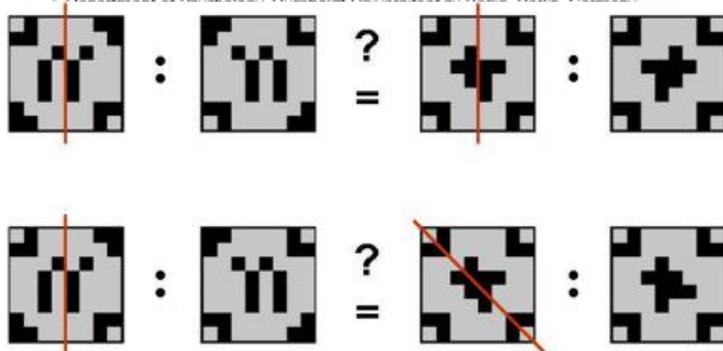
The major challenge was the negative view many people held of intelligence tests, but this has changed dramatically as more imaging research shows that the test scores are related to the brain.

Fluid intelligence allows flexible recruitment of the parieto-frontal network in analogical reasoning

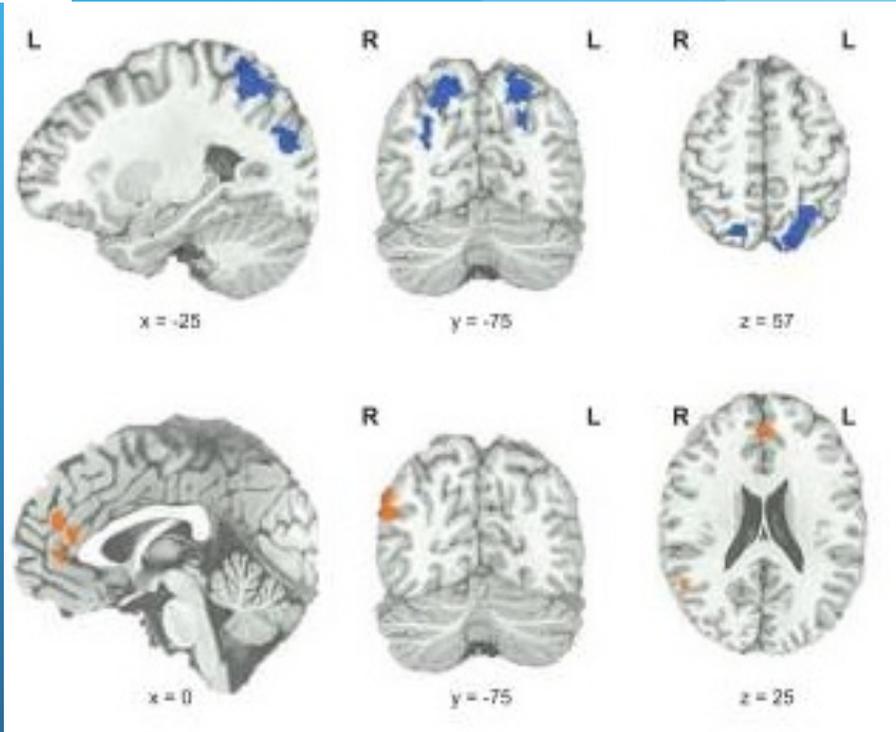
Franziska Preusse^{1,2,3*}, Elke van der Meer^{2,3}, Gopikrishna Deshpande^{4,5}, Frank Krueger⁶ and Isabell Wartenburger^{1,3,7}

¹ Department of Neurology, Berlin Neuroimaging Center, Charité – Universitätsmedizin Berlin, Berlin, Germany

² Department of Psychology, Humboldt University Berlin, Berlin, Germany



Main effect of fluid intelligence for hi-fluIQ > ave-fluIQ



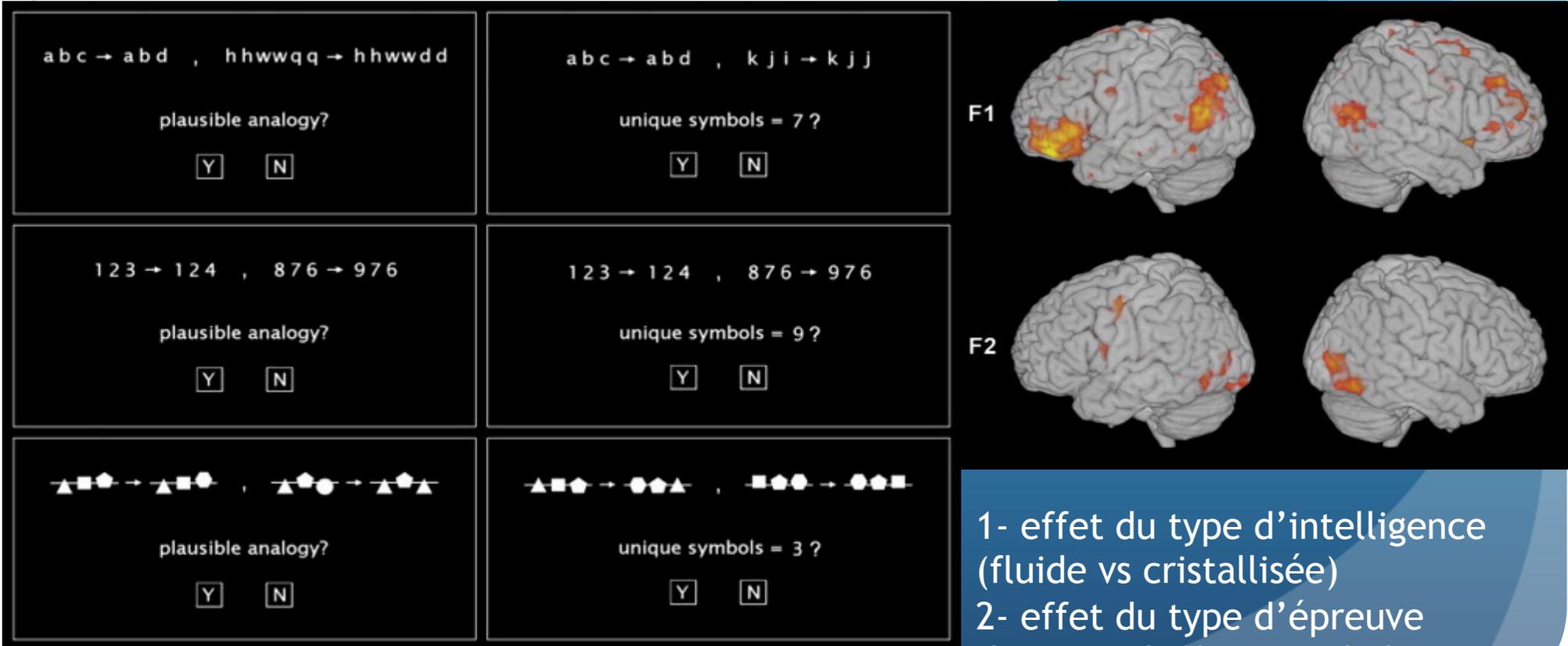
Main effect of fluid intelligence for ave-fluIQ > hi-fluIQ



Functional neural correlates of fluid and crystallized analogizing

John G. Geake^{a,b,d,*}, Peter C. Hansen^{a,b,c}

^a Department of Physiology, Anatomy and Genetics, University of Oxford, UK



1- effet du type d'intelligence (fluide vs cristallisée)
2- effet du type d'épreuve (lettres, chiffres, symboles)

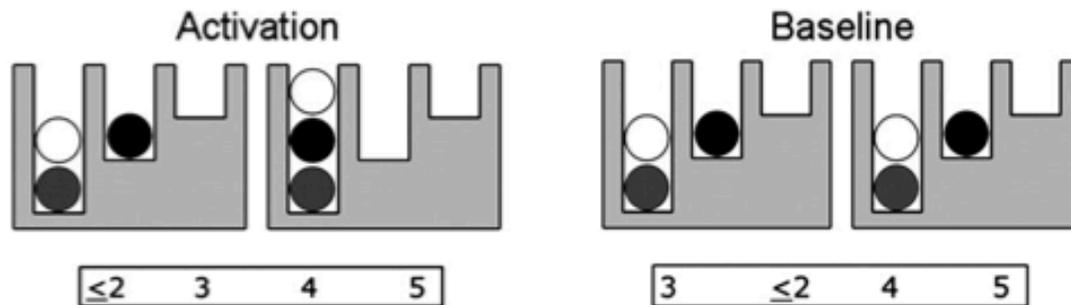


Mathematically gifted adolescents use more extensive and more bilateral areas of the fronto-parietal network than controls during executive functioning and fluid reasoning tasks

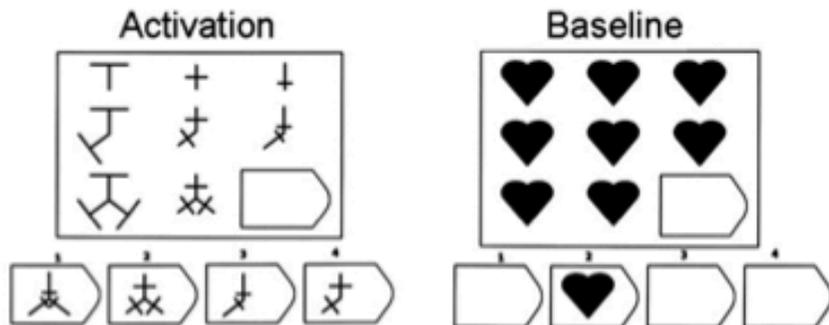
Manuel Desco ^{a,b,c}, Francisco J. Navas-Sanchez ^{b,c,*}, Javier Sanchez-González ^{c,d}, Santiago Reig ^{b,c}, Olalla Robles ^{e,f}, Carolina Franco ^e, Juan A. Guzmán-De-Villoria ^{b,g}, Pedro García-Barreno ^{b,c,h}, Celso Arango ^{b,e}

13 math-gifted adolescents and 14 controls with average mathematical skills. Patterns of activation specific to reasoning tasks in math-gifted subjects were examined using functional magnetic resonance images acquired while the subjects were performing Raven's Advanced Progressive Matrices (RAPM) and the Tower of London (TOL) tasks

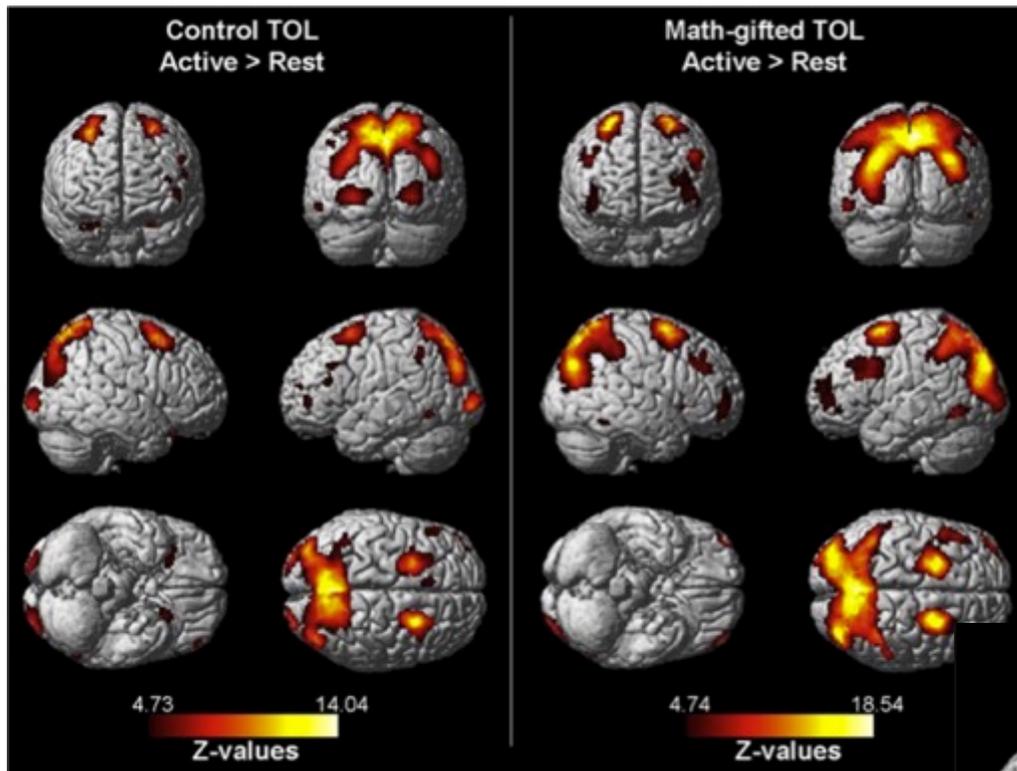
Tower of London test



Raven Progressive Matrices test

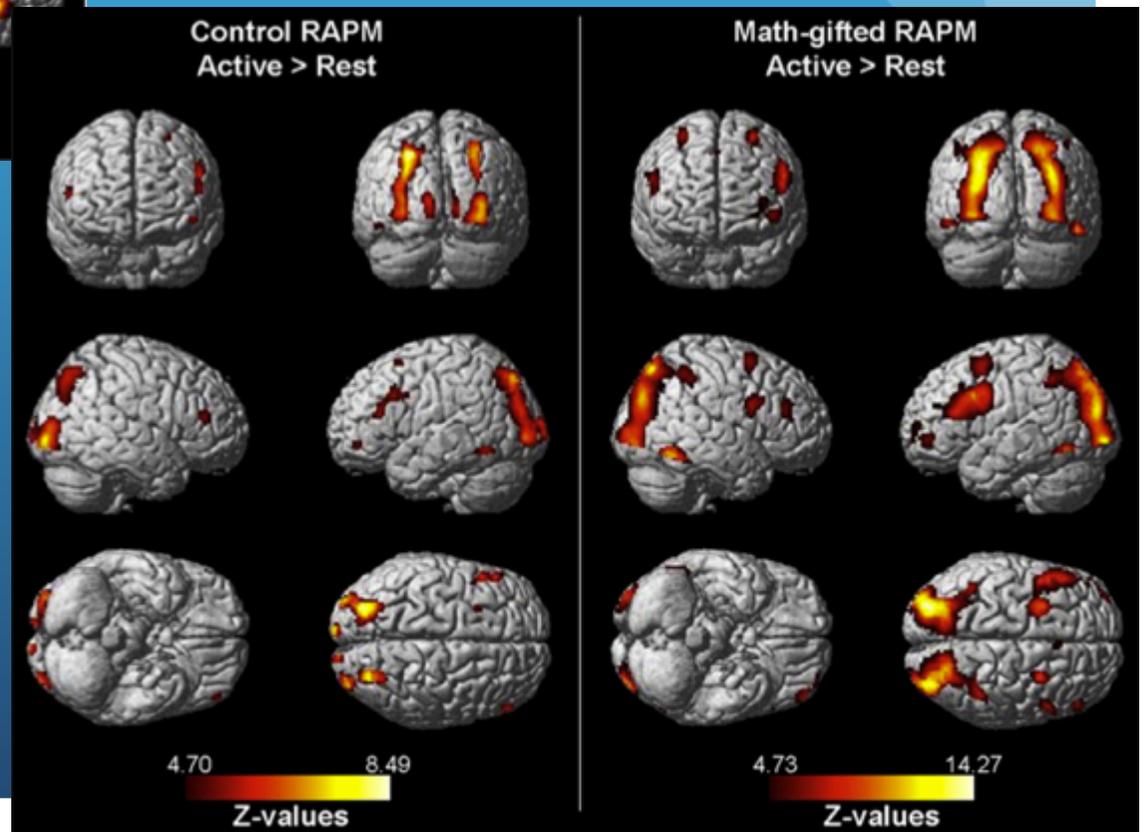


In contrast to an explanation based on neural efficiency, our study further supports this hypothesis of stronger recruitment of math-gifted children. Therefore, math-gifted subjects are qualitatively different in terms of the degree and location of activated brain regions.



Tour de Londres : plus forte activité en pariétal et frontal bilatéral chez math-gifted

Raven's progressive matrices : activité en pariéto-occipital plus forte et plus bilatérale



Brain spontaneous functional connectivity and intelligence

Ming Song,^a Yuan Zhou,^a Jun Li,^a Yong Liu,^a Lixia Tian,^c Chunshui Yu,^{b,*} and Tianzi Jiang^{a,*}

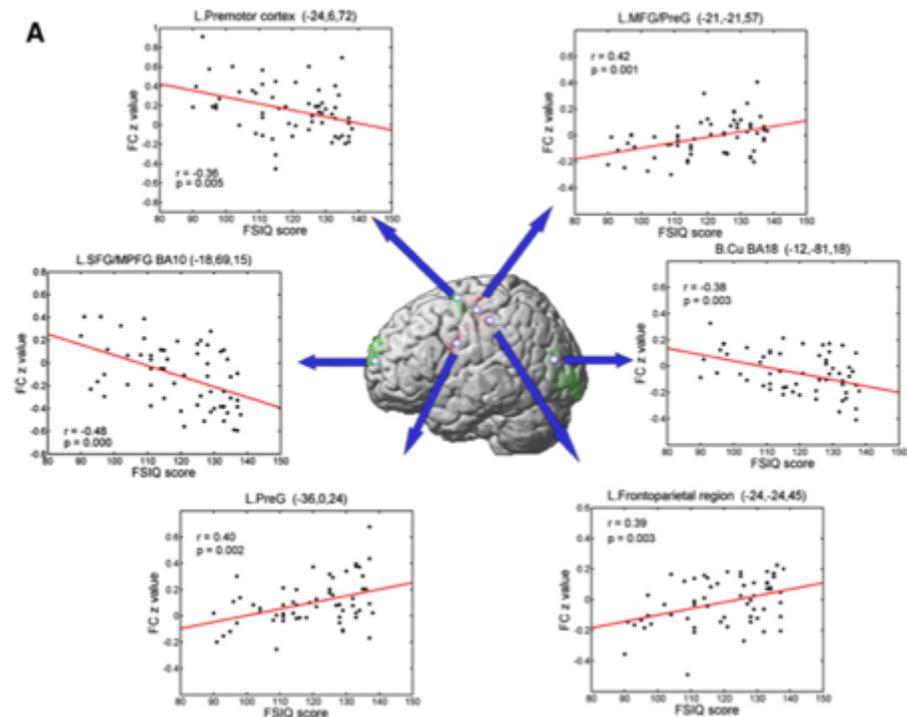
^aNational Laboratory of Pattern Recognition, Institute of Automation, Chinese Academy of Sciences, Beijing 100080, PR China

^bDepartment of Radiology, Xuanwu Hospital of Capital Medical University, Beijing, 100053, PR China

^cDepartment of Biomedical Engineering, School of Computer and Information Technology, Beijing Jiaotong University, Beijing 100044, PR China

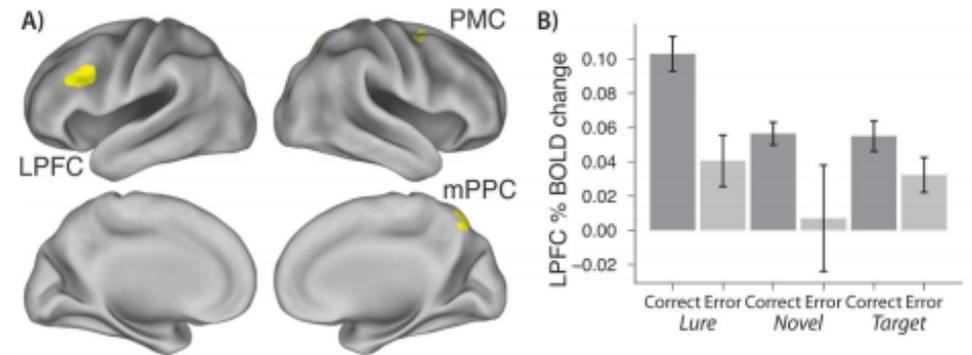
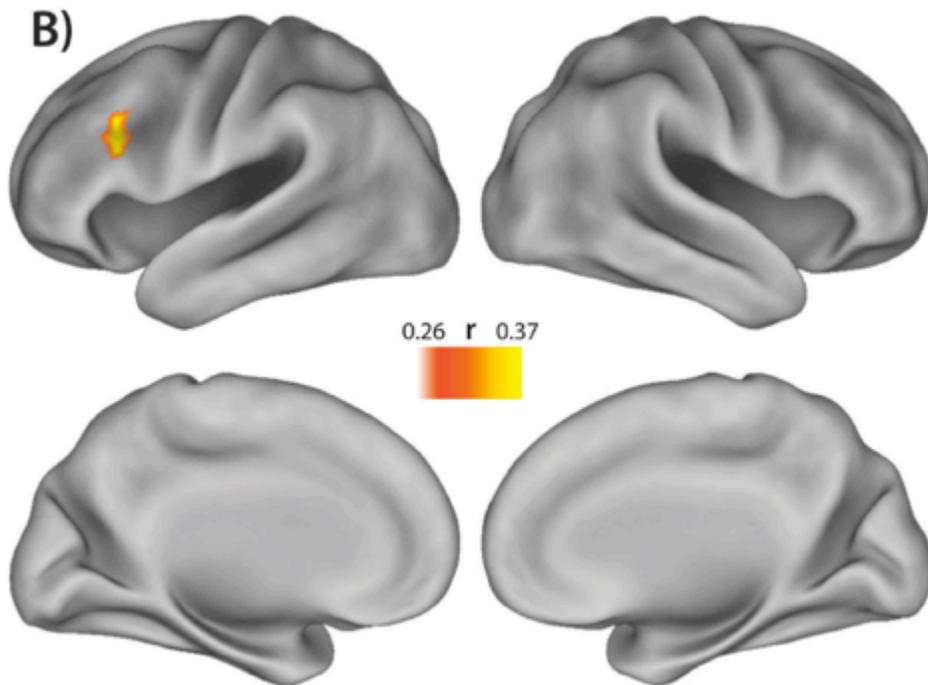
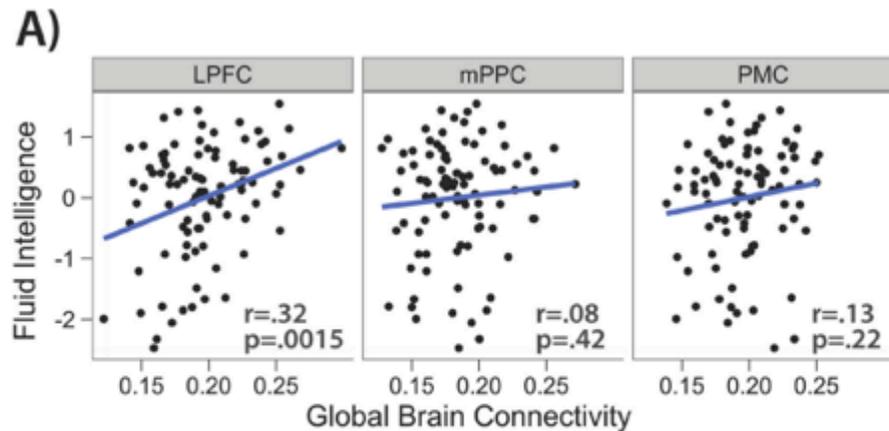
Connectivity within the frontal lobe and between the frontal and posterior brain regions were both important predictive factors for the differences in intelligence. These findings support a network view of intelligence, as suggested in previous studies.

More importantly, our findings suggest that brain activity may be relevant to the differences in intelligence even in the resting state and in the absence of an explicit cognitive demand.

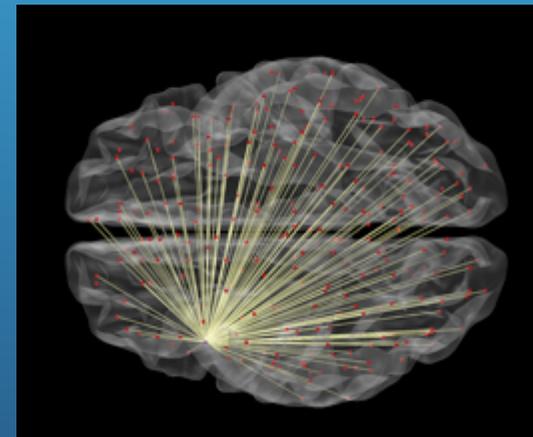


Global connectivity of prefrontal cortex predicts cognitive control and intelligence

Michael W. Cole, Tal Yarkoni, Grega Repovs, Alan Anticevic, and Todd S. Braver



A lateral prefrontal cortex (LPFC) region's activity was found to predict performance in a high control demand working memory task, and also to exhibit high global connectivity



The degree of global connectivity of this same region was found correlated to a measure of fluid intelligence

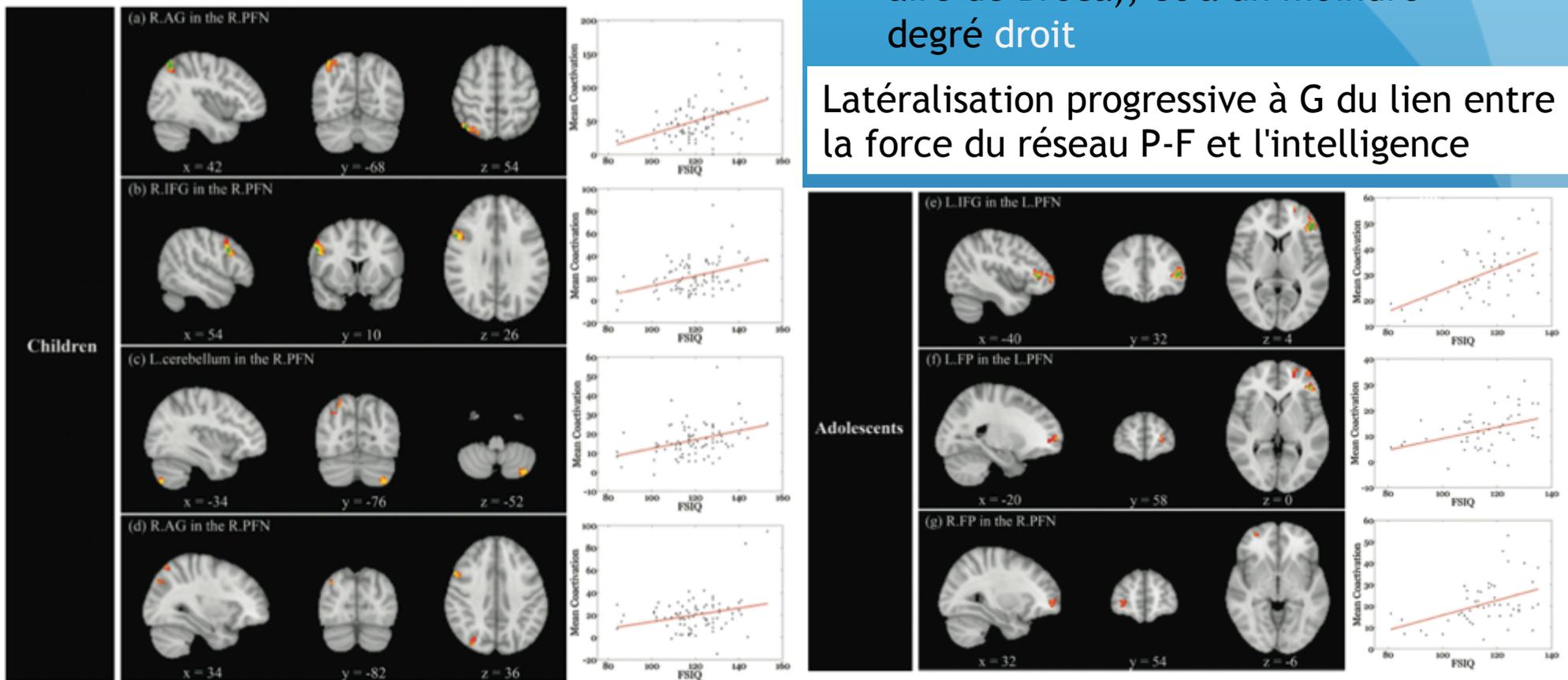
Association between Resting-State Coactivation in the Parieto-Frontal Network and Intelligence during Late Childhood and Adolescence

C. Li and L. Tian

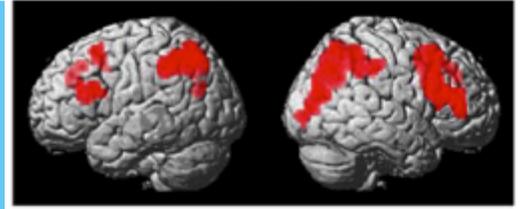
(Université de Pékin)
IRMf de repos chez 84 enfants (8-11a) et 50 adolescents (12-16a).

activation du réseau pariéto-frontal:
- chez l'enfant corrélation entre QIT et réseau pariéto-frontal droit (pôle frontal et gyrus angulaire)
- chez l'adolescent corrélation entre QIT et réseau gauche (pôle et aire de Broca), et à un moindre degré droit

Latéralisation progressive à G du lien entre la force du réseau P-F et l'intelligence



En résumé : les données de neuro-imagerie fonctionnelle



- Montrent une convergence de résultats en faveur d'une suractivation chez l'HP d'un circuit bilatéral fronto-pariétal, dont l'activité est fortement liée au QI
- Ce circuit est non seulement suractivé lors de tâches cognitives, verbales ou non verbales, mais aussi au repos en dehors de toute tâche cognitive
- Mais ce circuit fronto-pariétal n'est pas le substrat unique de l'intelligence : un lien fort existe entre l'intelligence et le degré de connectivité globale qui caractérise certaines parties de ce circuit.
- Une possible évolution de l'enfance à l'adolescence du lien entre ce réseau P-F et l'intelligence mesurée pourrait traduire une asymétrie de maturation des circuits droit et gauche, possiblement à l'origine de profils hétérogènes d'intelligence (et de précocité)

Imagerie morphologique

S.blanche

S. grise

DTI : tractographie

VBM : morphométrie
voxel à voxel

Directionnalité des
fibres blanches

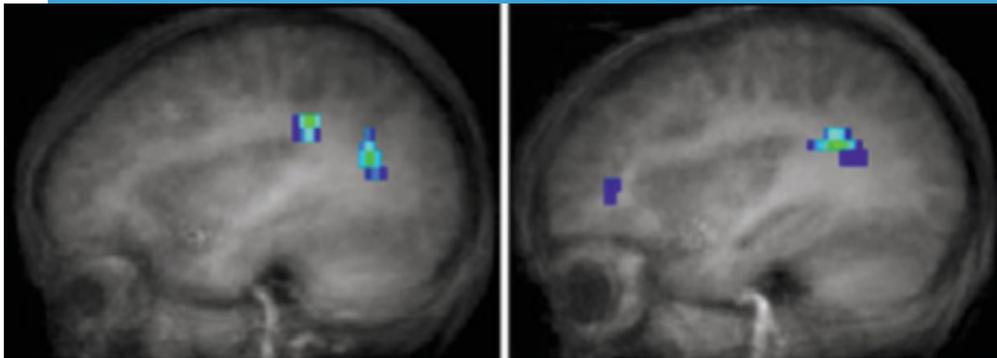
Épaisseur du cortex

connectivité

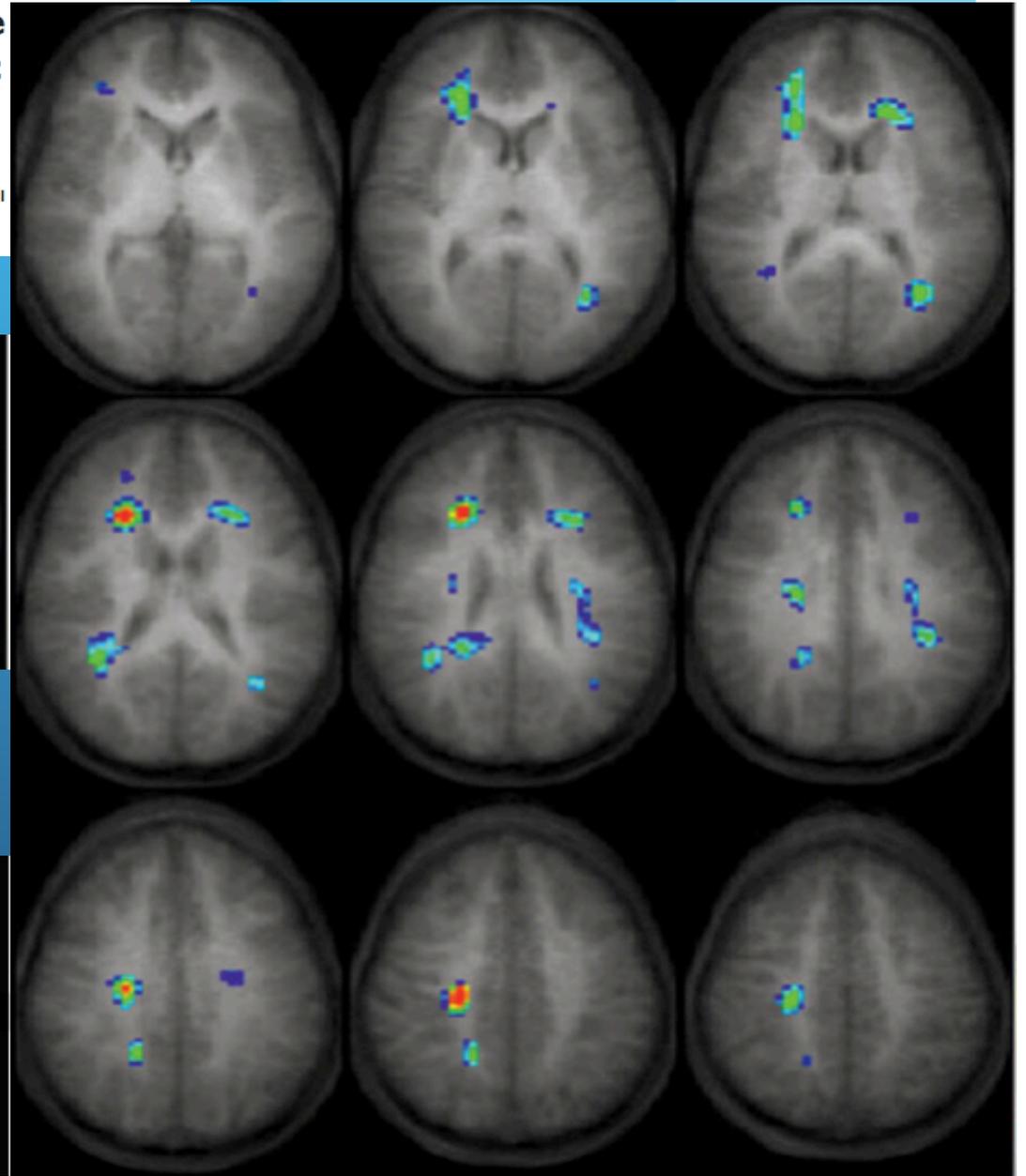
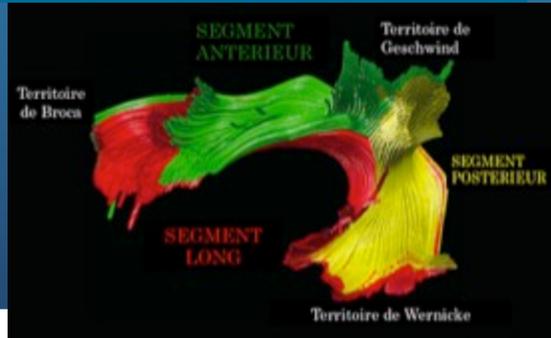
Trajectoire
développementale

Cognitive Functions Correlate With White Matter Architecture in a Normal Pediatric Population: A Diffusion Tensor MRI Study

Vincent J. Schmithorst,^{1*} Marko Wilke,^{1–3} Bernard J. Dardzinski,¹ and Scott K. Holland¹



Régions de corrélation positive entre anisotropie (FA) et QI total



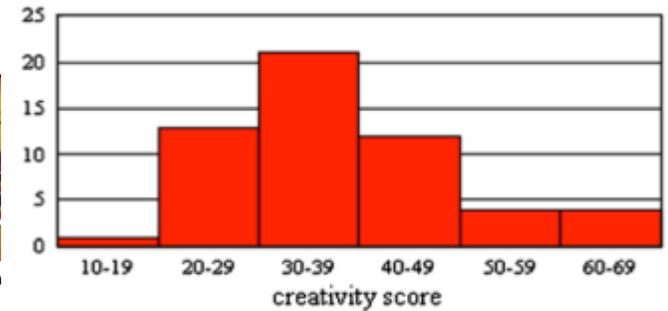
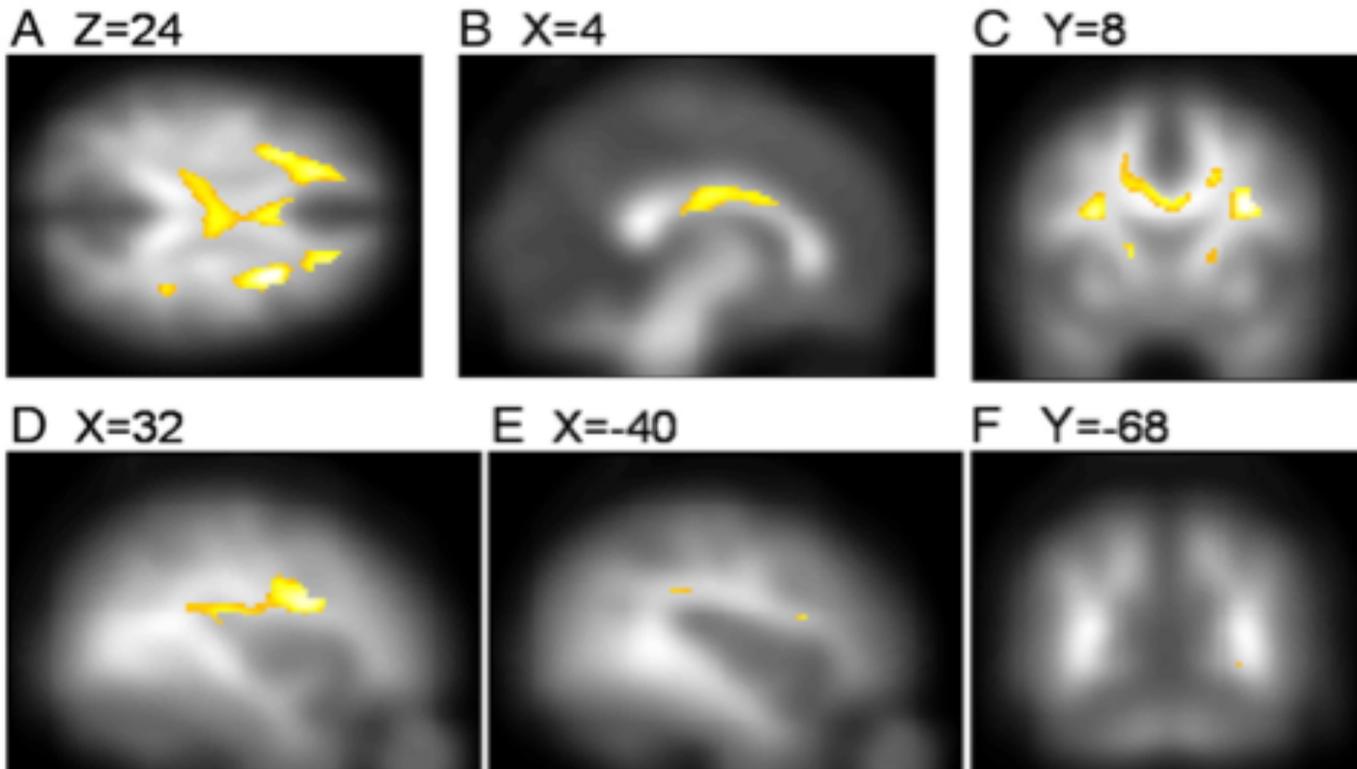


Fig. 1. Distribution of the scores from the S-A creativity test in our sample.

White matter structures associated with creativity: Evidence from diffusion tensor imaging

Hikaru Takeuchi ^{a,*}, Yasuyuki Taki ^a, Yuko Sassa ^a, Hiroshi Hashizume ^a, Atsushi Sekiguchi ^b, Ai Fukushima ^b, Ryuta Kawashima ^{a,b,c}

Corrélation significative avec score de créativité



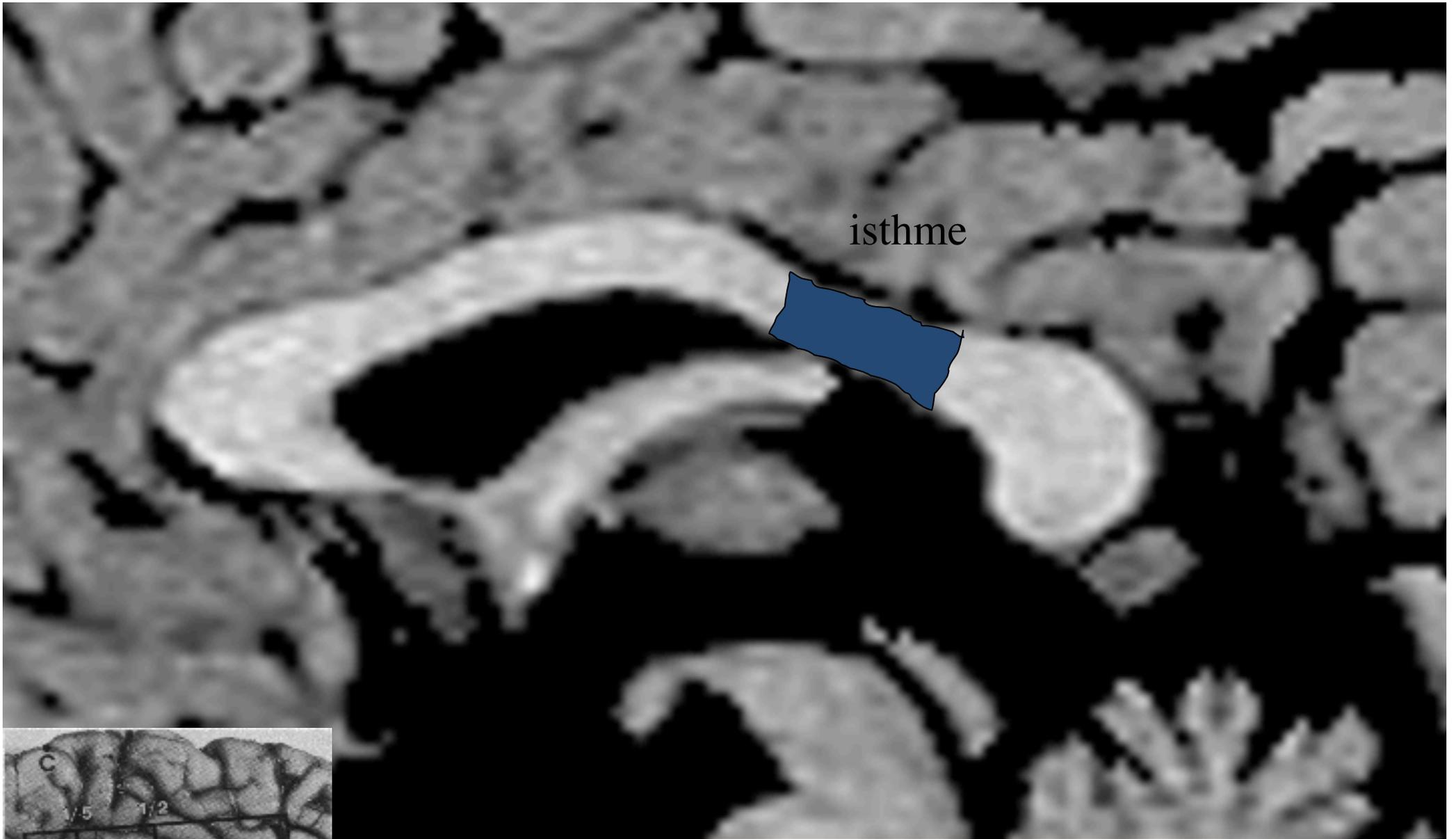
"test de créativité (divergent thinking")

3 types de questions : "en plus de la lecture, à quoi peut servir un journal?" : ex: pour envelopper les choses

"quelles sont les caractéristiques d'un bon appareil de télé?" ex.: recevoir des émissions du monde entier'

"Qu'arriverait-il s'il n'y avait plus de souris sur terre ex.: le monde serait plus propre

On évalue : a) la fluence (aptitude à donner le plus grand nombre de réponses différentes) b) la flexibilité (aptitude à donner des réponses dans des champs différents) c) l'originalité (différence /réponses standard; d) l'élaboration : aptitude à entrer dans les détails



**The Brain Connection:
The Corpus Callosum Is Larger in Left-Handers**

Witelson, S.F. (1985), *Science*, 229: 665-666

Positive correlations between corpus callosum thickness and intelligence

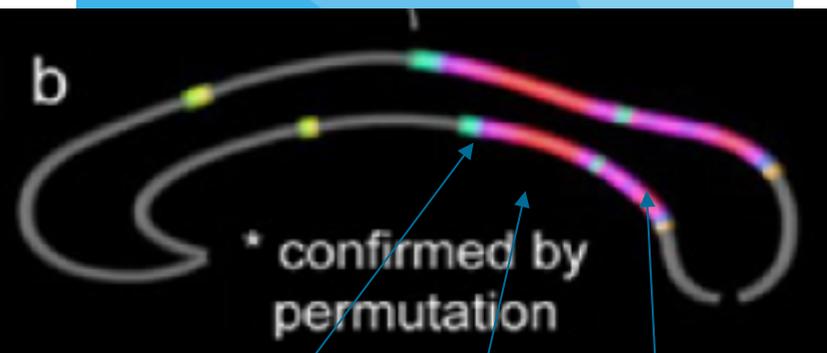
Eileen Luders,^a Katherine L. Narr,^a Robert M. Bilder,^{b,c} Paul M. Thompson,^a
 Philip R. Szeszko,^d Liberty Hamilton,^a and Arthur W. Toga^{a,*}

^aLaboratory of Neuro Imaging, Department of Neurology, UCLA School of Medicine, 635 Charles Young Drive South, Suite 225, Los Angeles, CA 90095-7334, USA

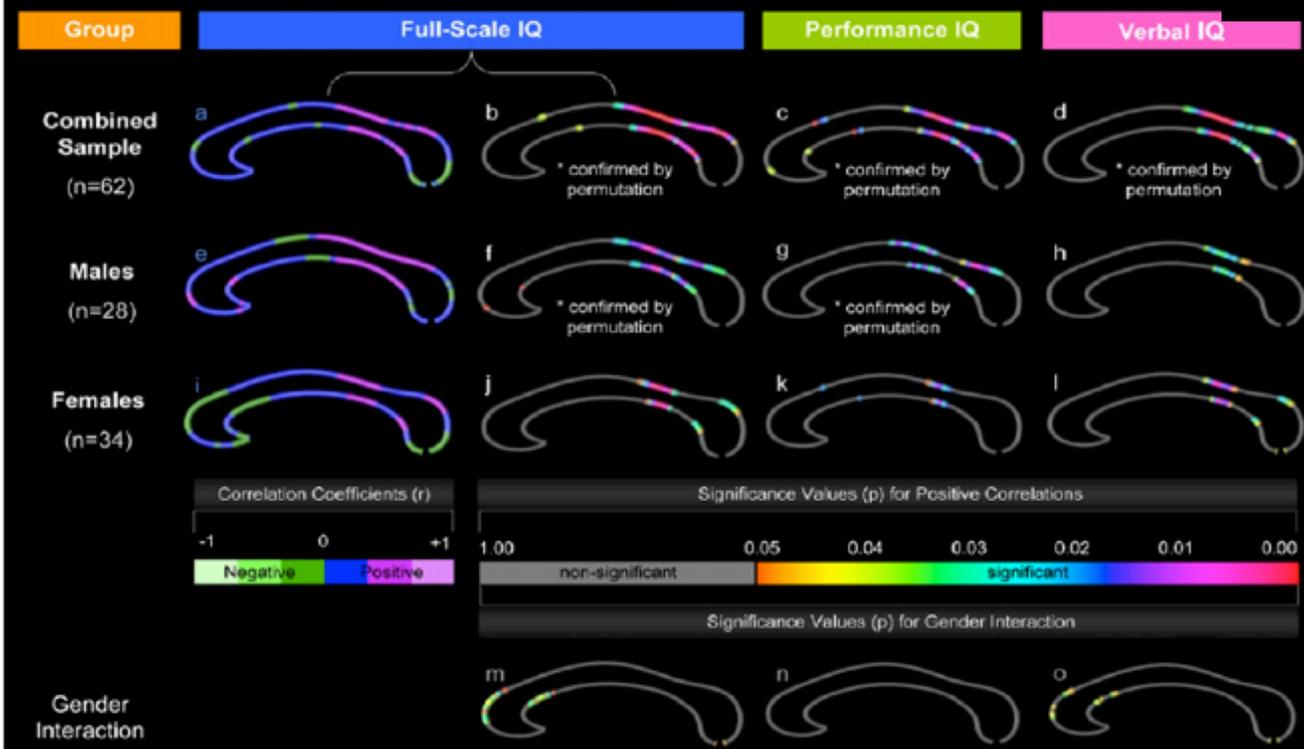
Correlations between callosal thickness and intelligence measures (corrected p -values computed by permutation testing for $p < 0.05$)

	Full-scale IQ	Performance IQ	Verbal IQ
Combined sample ($n=62$)	0.01*	0.01*	0.03*
Males ($n=28$)	0.03*	0.05*	0.17
Females ($n=34$)	0.09	0.28	0.11
Gender interaction	0.15	1.00	0.27

The asterisk (*) denotes significant findings.



Correlations between Callosal Thickness & Intelligence



Tronc postérieur
 Pre-splénium
 isthme

Corrélations positives avec QI total, QI verbal e QI performance

White Matter Microstructure Correlates of **Mathematical Giftedness** and Intelligence Quotient

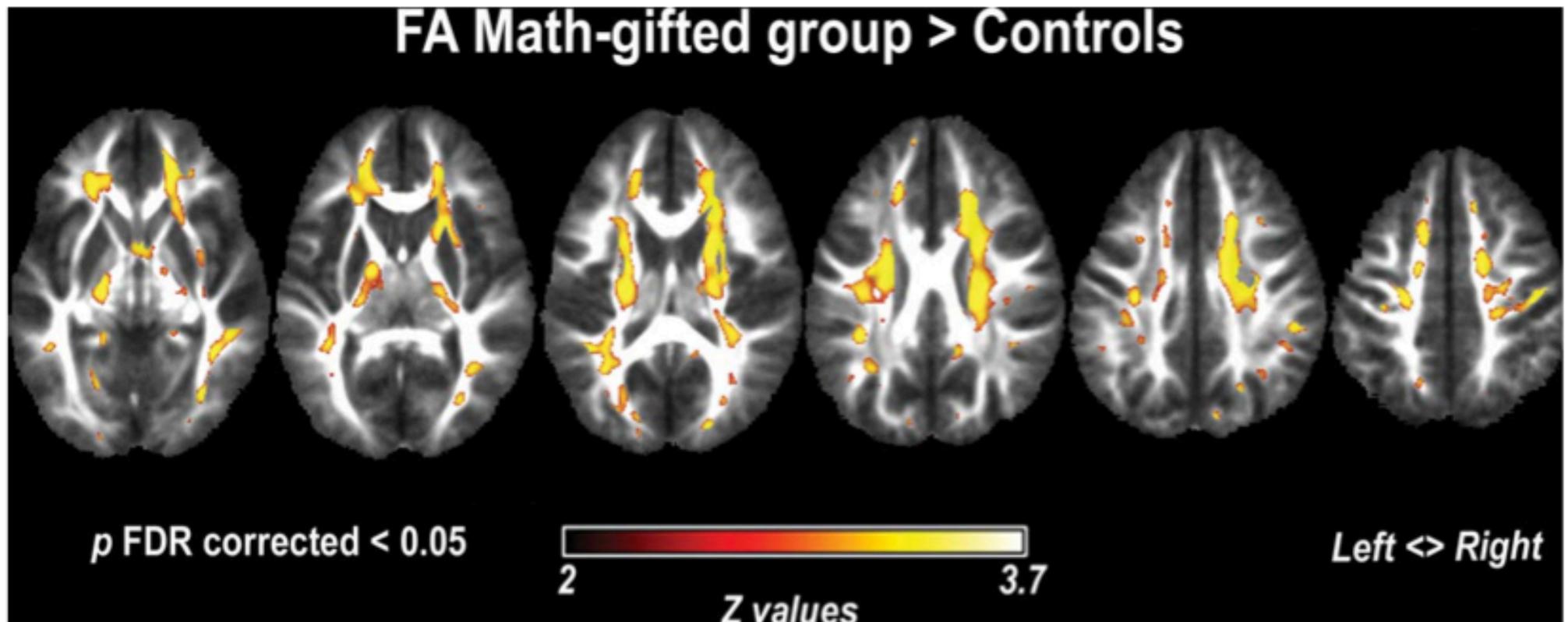
Francisco J. Navas-Sánchez,^{1,2*} Yasser Alemán-Gómez,^{1,2}
 Javier Sánchez-Gonzalez,³ Juan A. Guzmán-De-Villoria,⁴ Carolina Franco,⁵
 Olalla Robles,^{5,6} Celso Arango,^{2,5} and Manuel Desco^{1,2,7}

¹Unidad de Medicina y Cirugía Experimental, Hospital General Universitario Gregorio Marañón, Instituto de Investigación Sanitaria Gregorio Marañón, Madrid, Spain

TABLE I. Mean and standard deviation (SD) of demographic data for each group

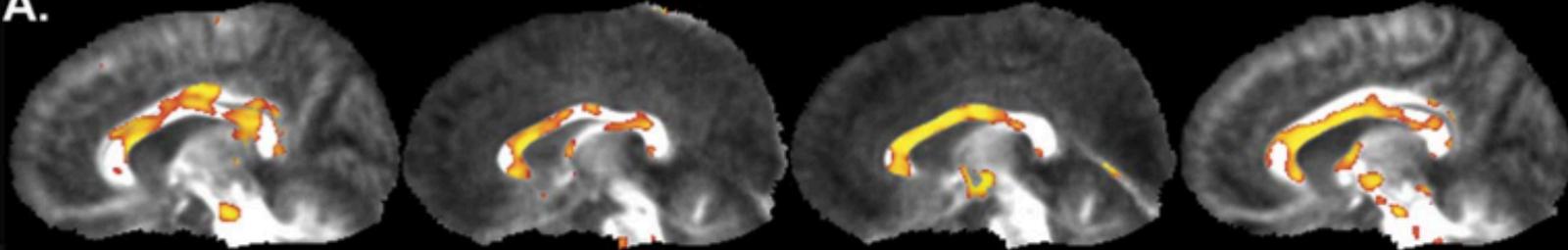
	Controls (n = 23)		Math-gifted (n = 13)		Pa
	Mean	SD	Mean	SD	
Age (years)	13.42	0.86	13.75	0.57	
Age (months)	160.91	10.31	165.01	7	
Gender (male\female)	19\4		8\5		
Handedness (right\left\mixed)	23\0\0		13\0\0		
Estimated full-scale IQ	105.48	15.71	130.77	10.68	<0.001
Verbal IQ	106.83	16.67	125.08	12.07	<0.001
Performance IQ	99.83	23.1	128.85	12.14	<0.001

^a Student's *t* test of differences between groups.

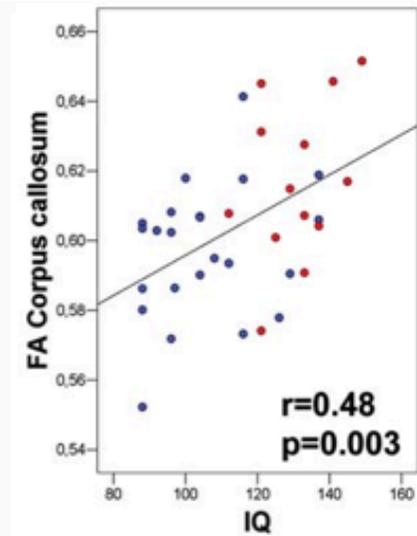
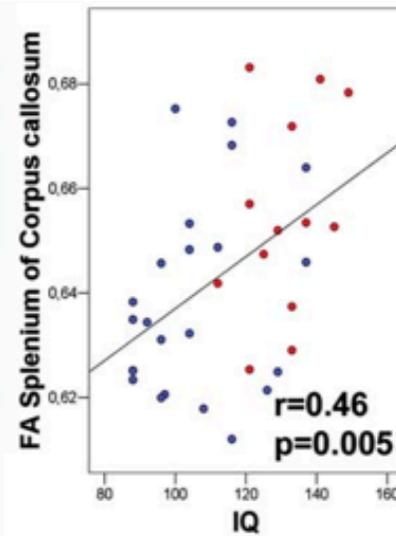
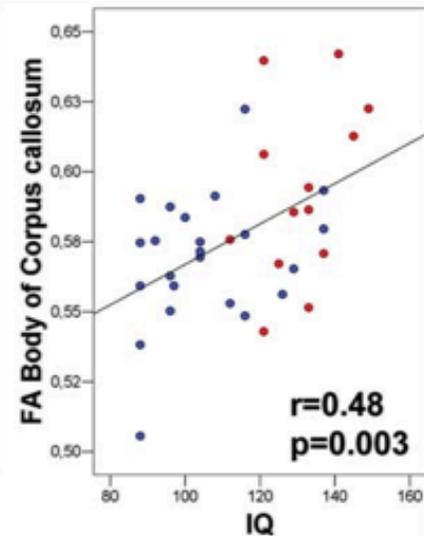
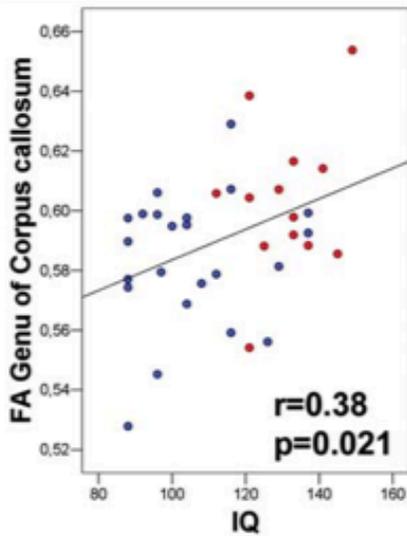
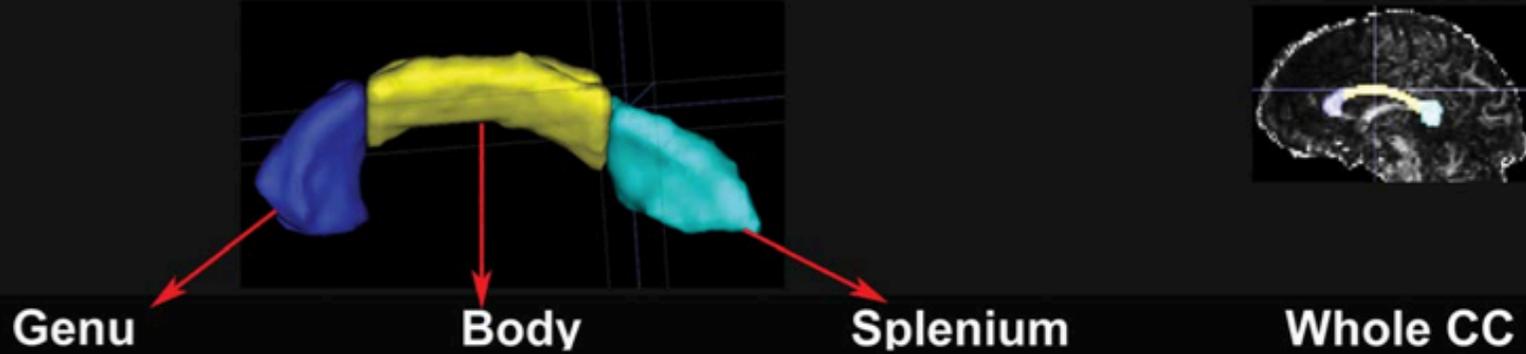


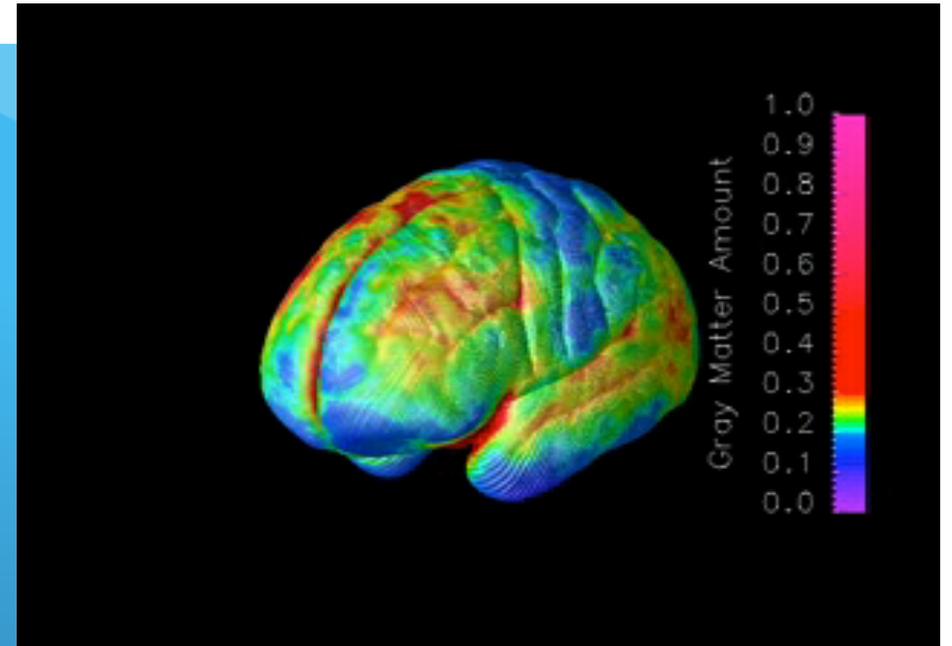
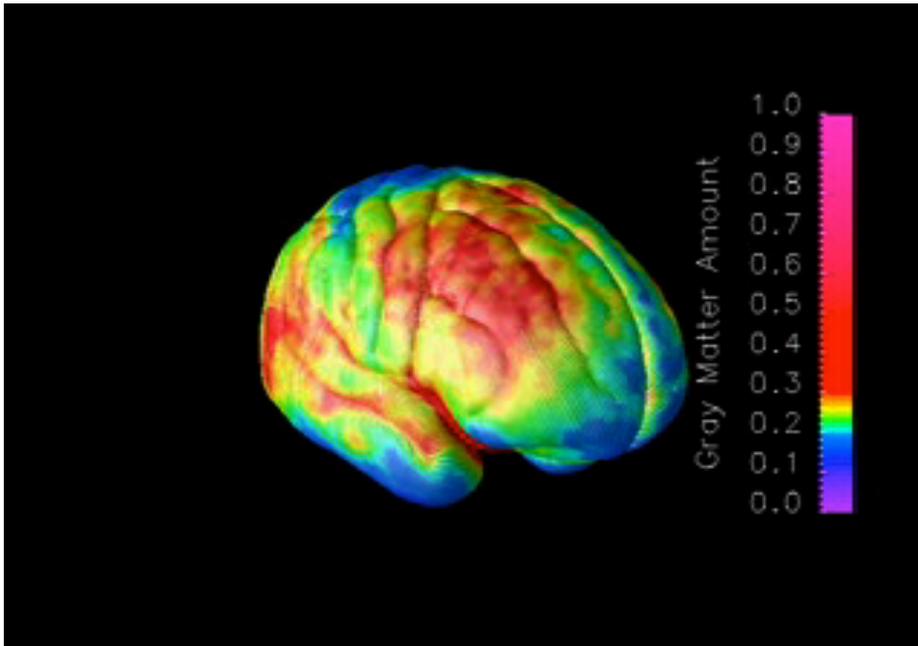
CORRELATION FA & IQ

A.

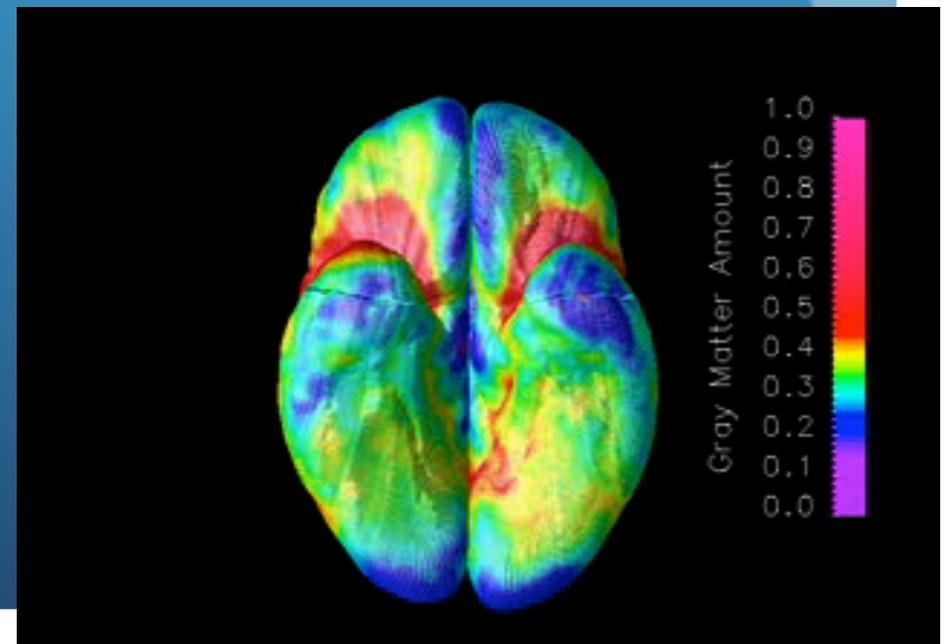
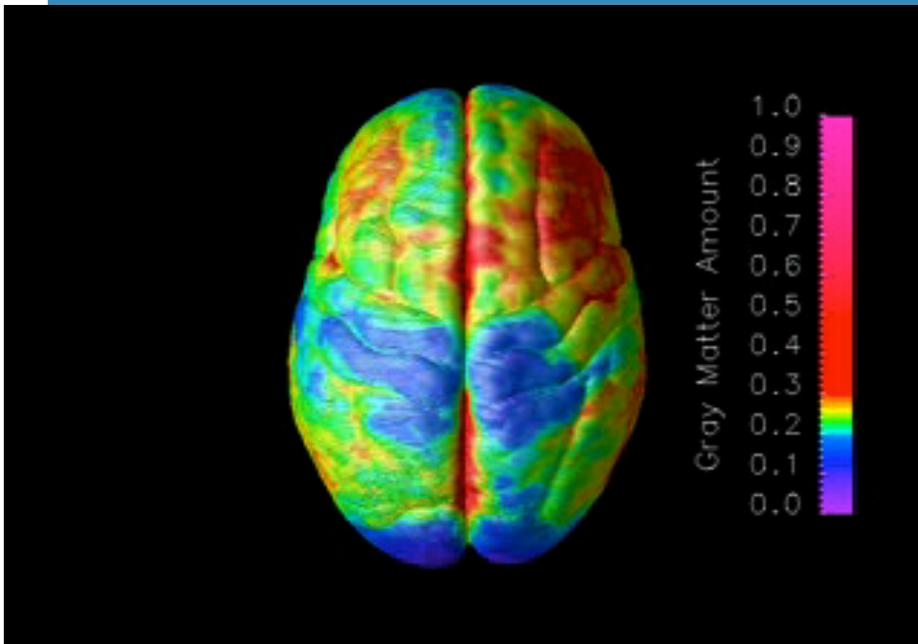


B.





gray matter maturation over the cortical surface between ages 4 and 21 (Gogtay et al. /pnas, 2004)



LETTERS

Intellectual ability and cortical development in children and adolescents

P. Shaw¹, D. Greenstein¹, J. Lerch², L. Clasen¹, R. Lenroot¹, N. Gogtay¹, A. Evans², J. Rapoport¹ & J. Giedd¹

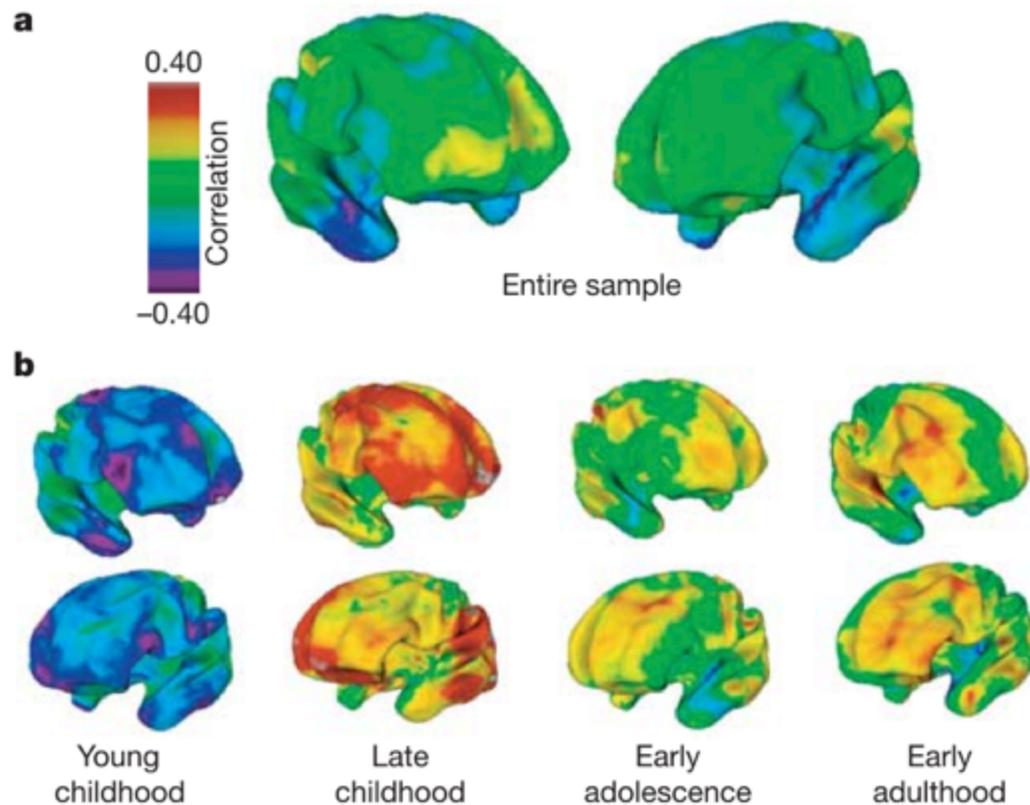
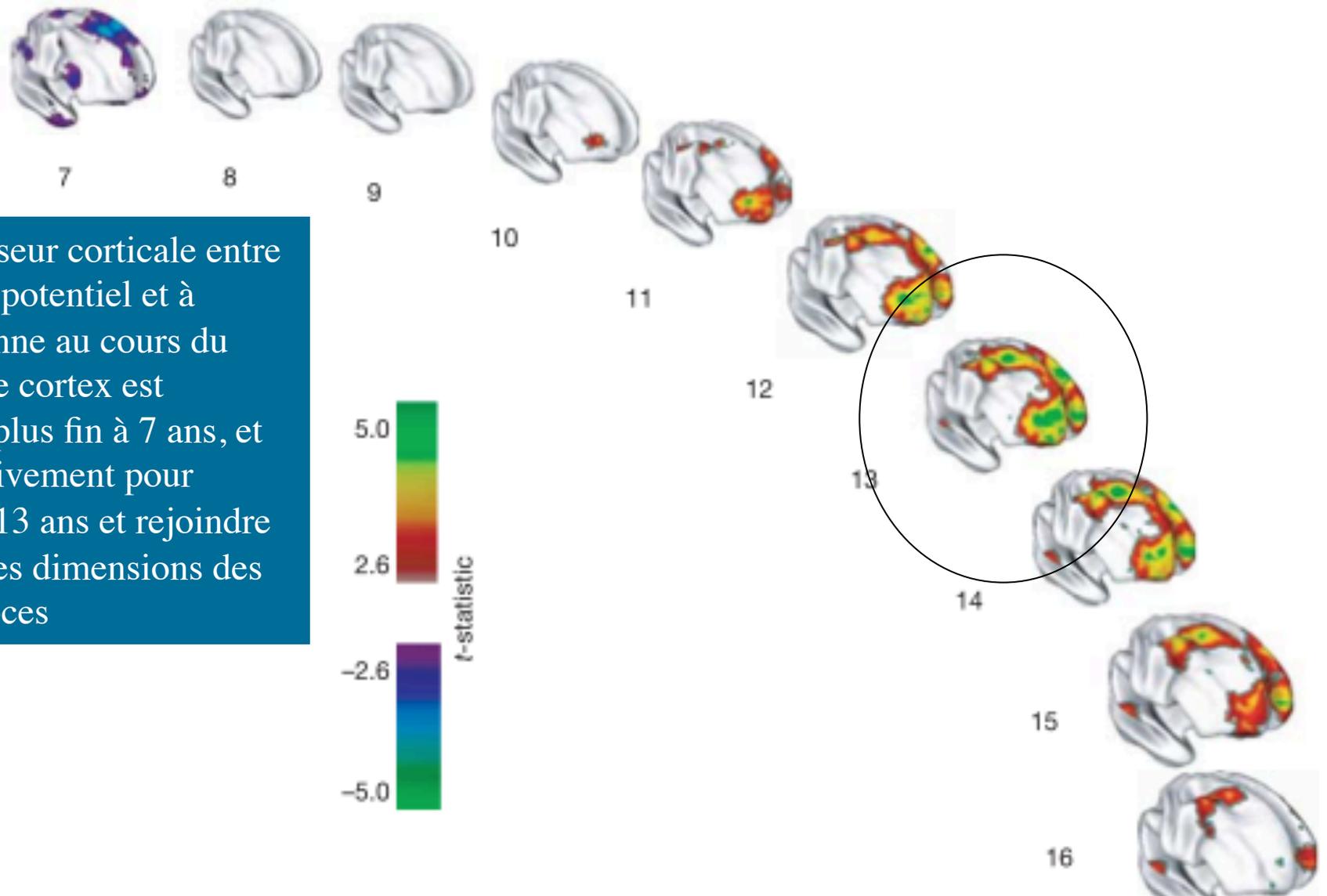


Figure 1 | Correlations between IQ and cortical thickness. a, Pearson's correlations for all 207 subjects were generally positive and modest

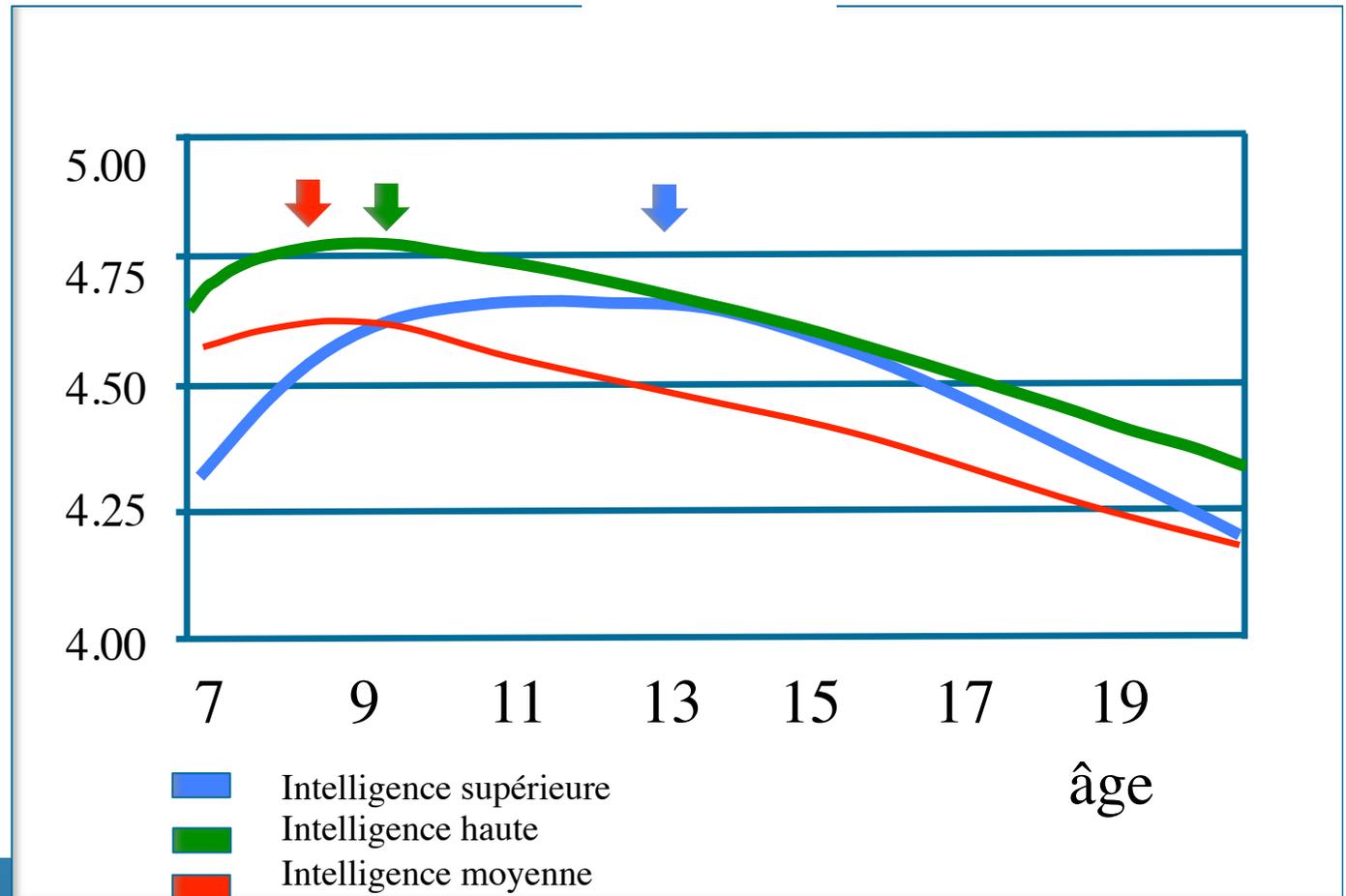
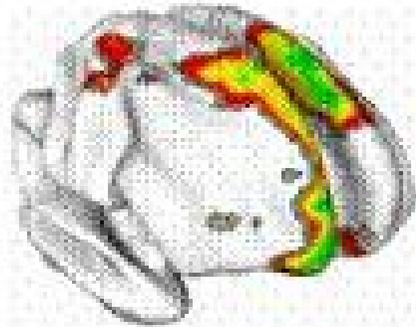
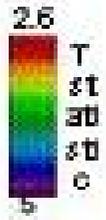
Corrélation entre l'épaisseur corticale et le QI en fonction de l'âge: corrélation négative dans la petite enfance, très positive chez les grands enfants, positive à un moindre degré à l'adolescence



Différence d'épaisseur corticale entre des enfants à haut potentiel et à intelligence moyenne au cours du développement : le cortex est significativement plus fin à 7 ans, et s'épaissit progressivement pour atteindre un pic à 13 ans et rejoindre progressivement les dimensions des témoins non précoces

Figure 4 | Developing differences in cortical thickness between the superior and average intelligence groups. Group differences are represented by *t*-statistics ($t > 2.6$), and show that the superior intelligence group has a thinner superior prefrontal cortex at the earliest age (purple

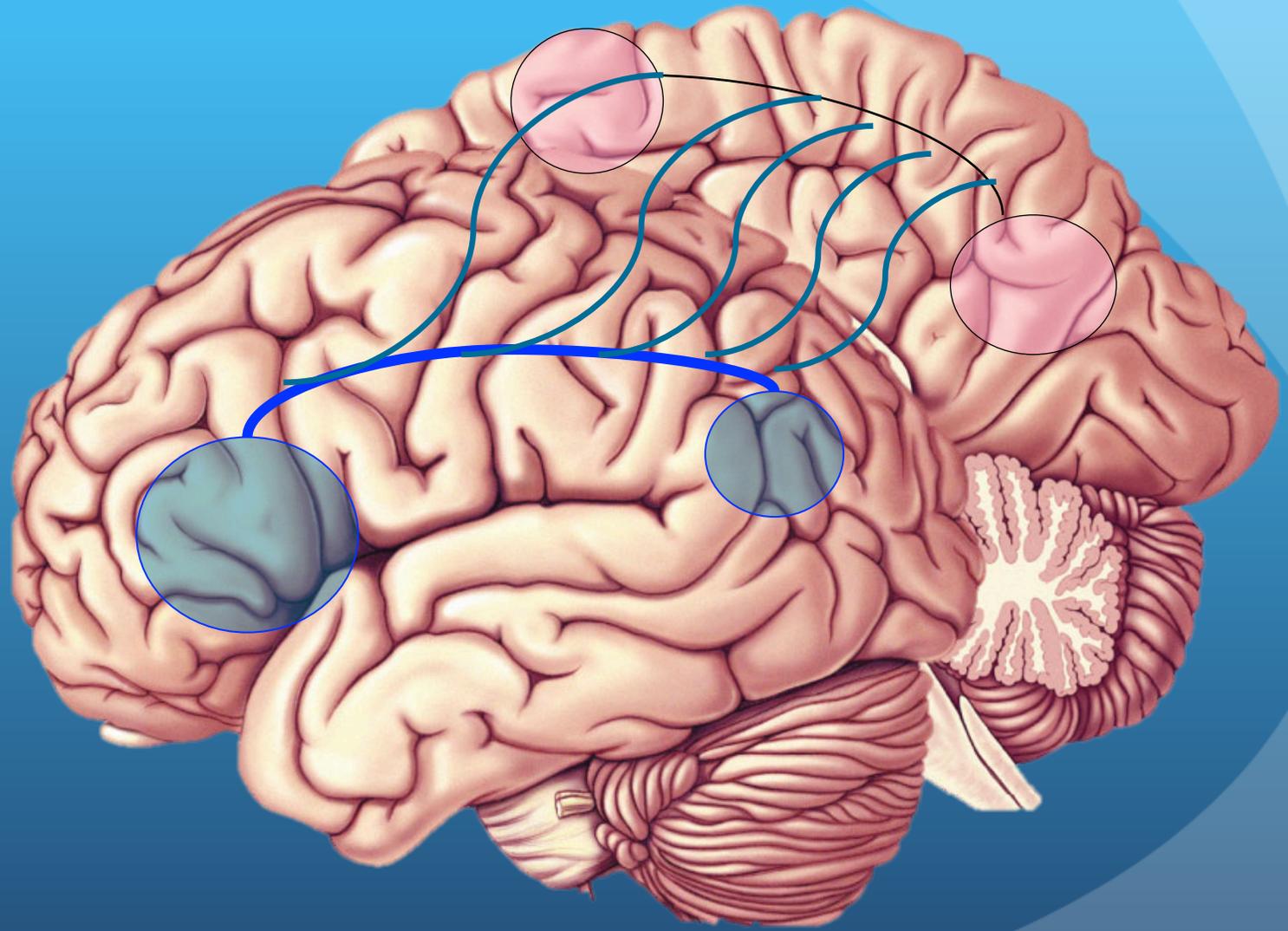
regions). There is then a rapid increase in cortical thickness (red, green and yellow regions) in the superior intelligence group, peaking at age 13 and waning in late adolescence.



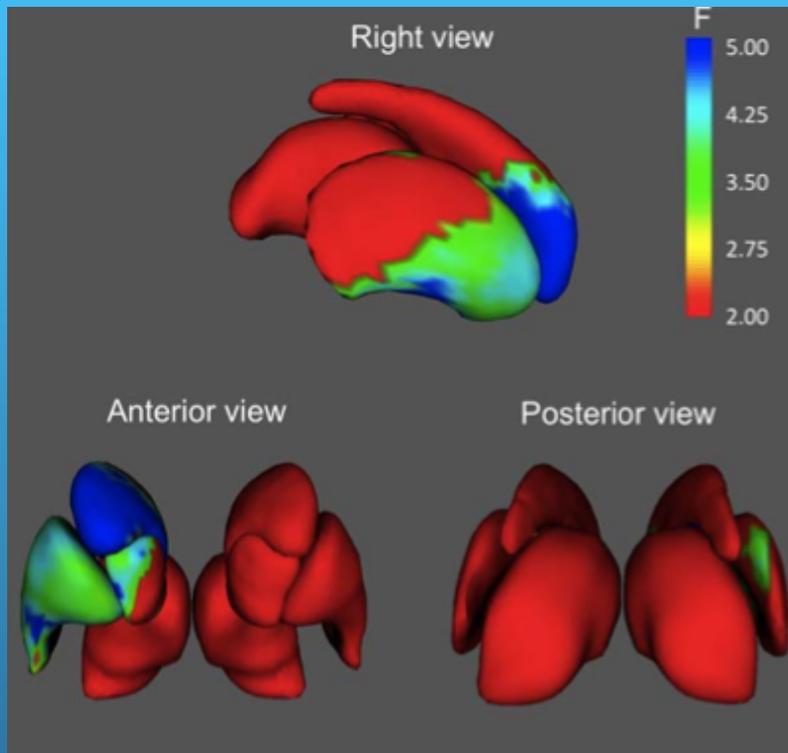
300 IRM d'enfants de 7 à 18 ans: la dynamique structurale (évolution de l'épaisseur du cortex) est différente entre enfants à haut QI (121-145) par rapport à ceux à QI supra-moyen (109-120) et moyen (83-108)
 Donc la phase de croissance dendritique et synaptogenèse dure plus longtemps avant que ne commence la phase d'élimination des connexions superflues.

En résumé, le cerveau de l'HP possède deux particularités

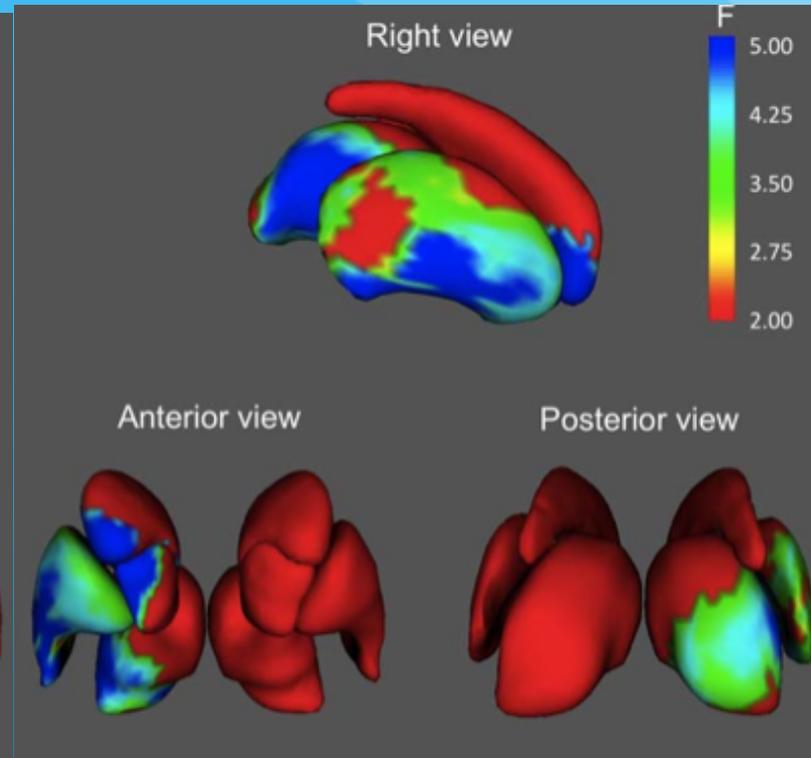
- Une plus forte densité des projections du lobe pariétal sur le cortex frontal, d'où une connectivité plus efficiente entre les régions perceptives/spatiales et les systèmes exécutifs, « expliquant » la qualité des raisonnements en particulier mathématiques
 - Une plus longue période de croissance du cortex pré-frontal avant que ne débute la période d'élagage des synapses, pourrait augmenter la période critique durant laquelle s'installent des connexions cruciales, mais aussi augmenter la probabilité d'un déséquilibre interhémisphérique de l'installation de ces connexions.
- Une asymétrie du tempo maturationnel entre les deux hémisphères pourrait alors expliquer que, dans certains cas les circuits fronto-temporaux du langage soient prêts trop précocement et que les circuits attentionnel et praxique, plus bilatéraux peinent au contraire à établir leurs connexions, donnant un profil "dyspraxique" à certains précoces inhomogènes.



Intelligence fluide



Intelligence spatiale



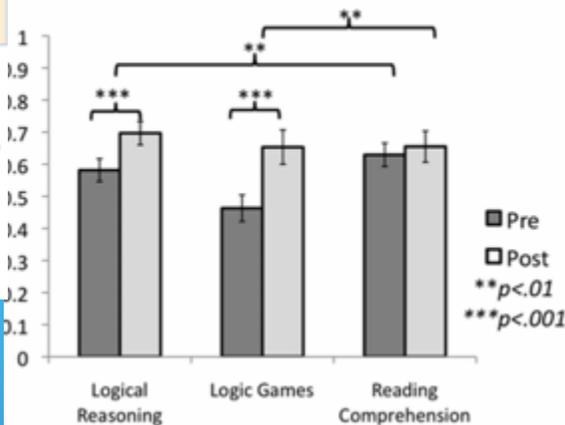
mesure des différentes parties des ganglions de la base, en relation avec l'intelligence fluide (à gauche) et l'intelligence spatiale (à droite). Les différents noyaux (putamen, noyau caudé, thalamus), en particulier du côté droit, sont corrélés à ces deux types d'intelligence, mais pas à l'intelligence cristallisée, qui fait appel à des connaissances acquises (d'après Burgaleta et al., 2014).

Intensive reasoning training alters patterns of brain connectivity at rest

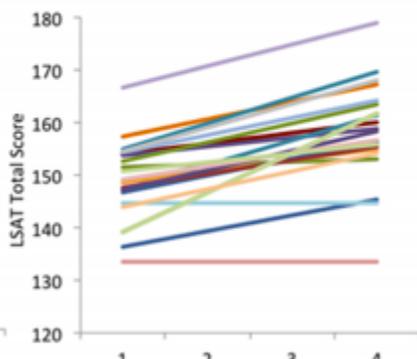
Allyson P. Mackey¹, Alison T. Miller Singley², and Silvia A. Bunge^{1,2}
¹Helen Willis Neuroscience Institute: 132 Barker Hall, Berkeley, CA, 94720
²Department of Psychology: 3210 Tolman Hall, Berkeley, CA, 94720

An analysis of pairwise correlations between brain regions implicated in reasoning showed that fronto-parietal connections were strengthened, along with parietal-striatal connections.

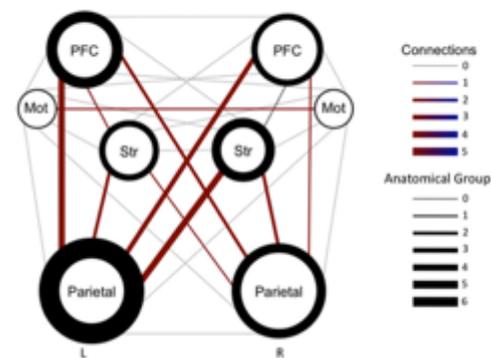
B. LSAT Subscores



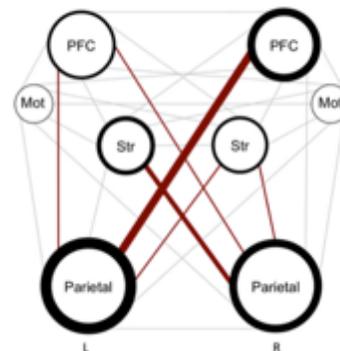
D. LSAT Improvement Slopes



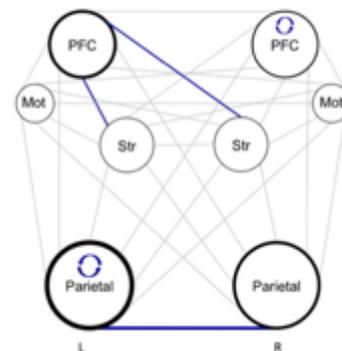
A. Connection Changes with Training



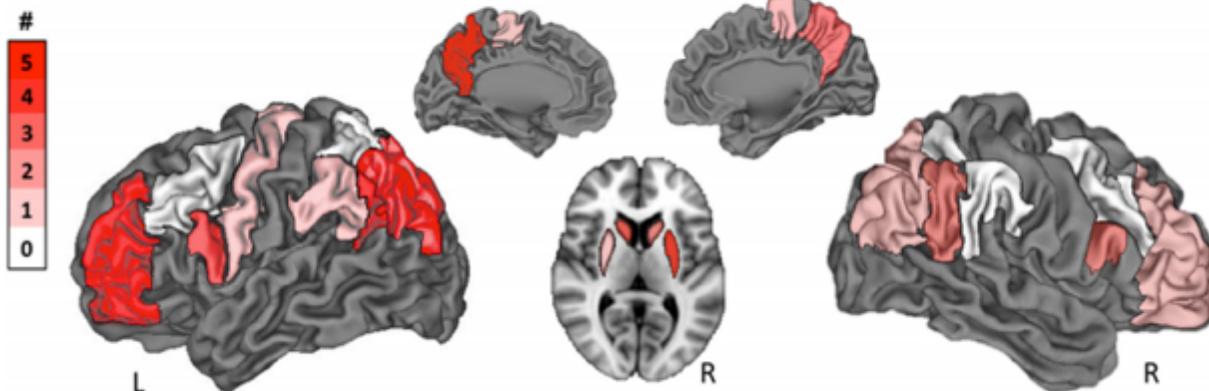
B. Positive Correlations with LSAT Improvement



C. Negative Correlations with LSAT Improvement



B. Regions Showing Correlation Changes



These findings provide strong evidence for neural plasticity at the level of large-scale networks supporting high-level cognition.



IQ-Related fMRI Differences during Cognitive Set Shifting

Steven Graham^{1,2}, Jiaying Jiang¹, Victoria Manning¹, Ayna Baladi Nejad¹, Koh Zhisheng¹, Shan R. Salleh¹, Xavier Golay³, Yeh Ing Berne⁴ and Peter J. McKenna⁵

Test de Wisconsin : activation cérébrale lors du changement de règle (shifting)
 Zones moins actives chez les précoces zones plus actives
 (Lors de la sélection des réponses) (lors de la réception du feedback)

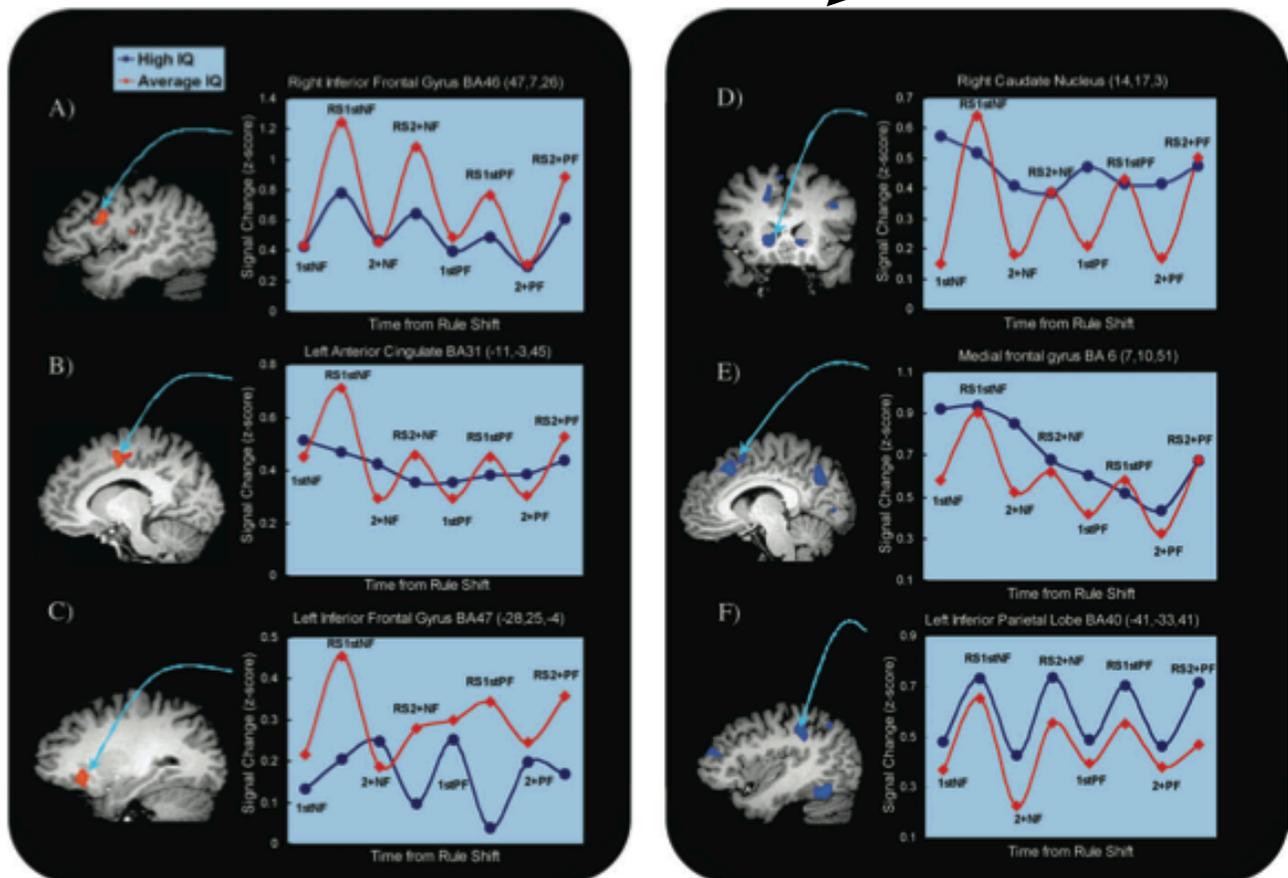
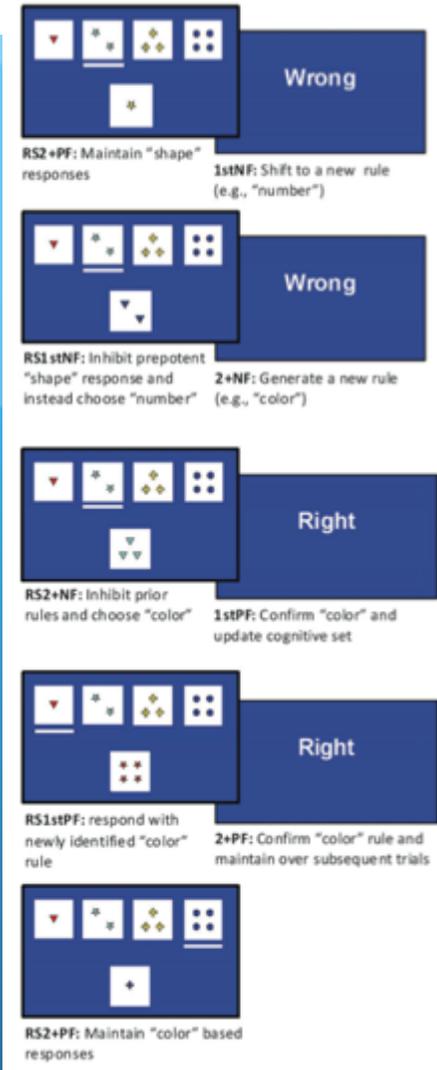


Figure 2. Regions of interest graphs depicting the signal change across the events from rule shift (A) right inferior frontal gyrus, (B) left anterior cingulate, (C) left inferior frontal gyrus, (D) caudate nucleus, (E) medial frontal gyrus, (F) left inferior parietal lobe.

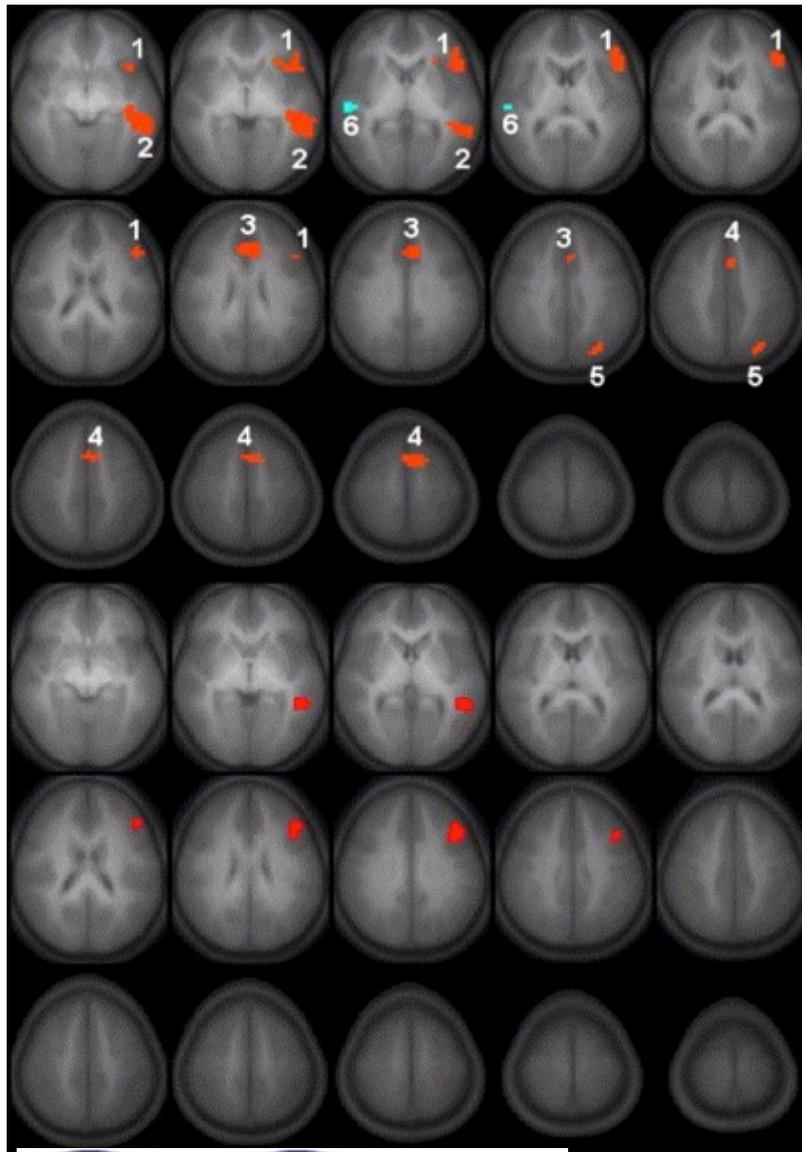
Whether greater intelligence is associated with more or less brain activity (the "neural efficiency" debate) depends therefore on the specific component of the task being examined as well as the brain region recruited.

Functional MRI evidence for disparate developmental processes underlying intelligence in boys and girls

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Received 6 December 2005; revised 10 January 2006; accepted 12 January 2006
Available online 15 March 2006

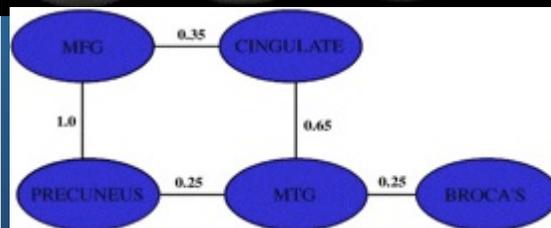


Régions montrant
une corrélation avec
le QI (pos=rouge,
neg=bleu)

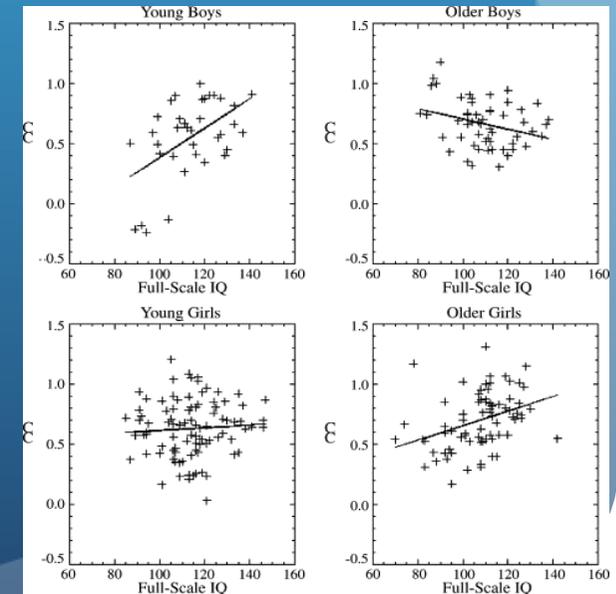
Régions montrant
une triple
interaction : QI x
sexe (G>F) x âge

Étude de connectivité au cours d'une
tâche de production lexico-
sémantique (génération de verbes)
chez 323 enfants de 6 à 18 ans, effet
du sexe sur la corrélation avec le QI
(Raven)

Effet inverse de
l'âge chez les
garçons et les filles



Poids relatifs (force
de la connexion) des
différentes
corrélations





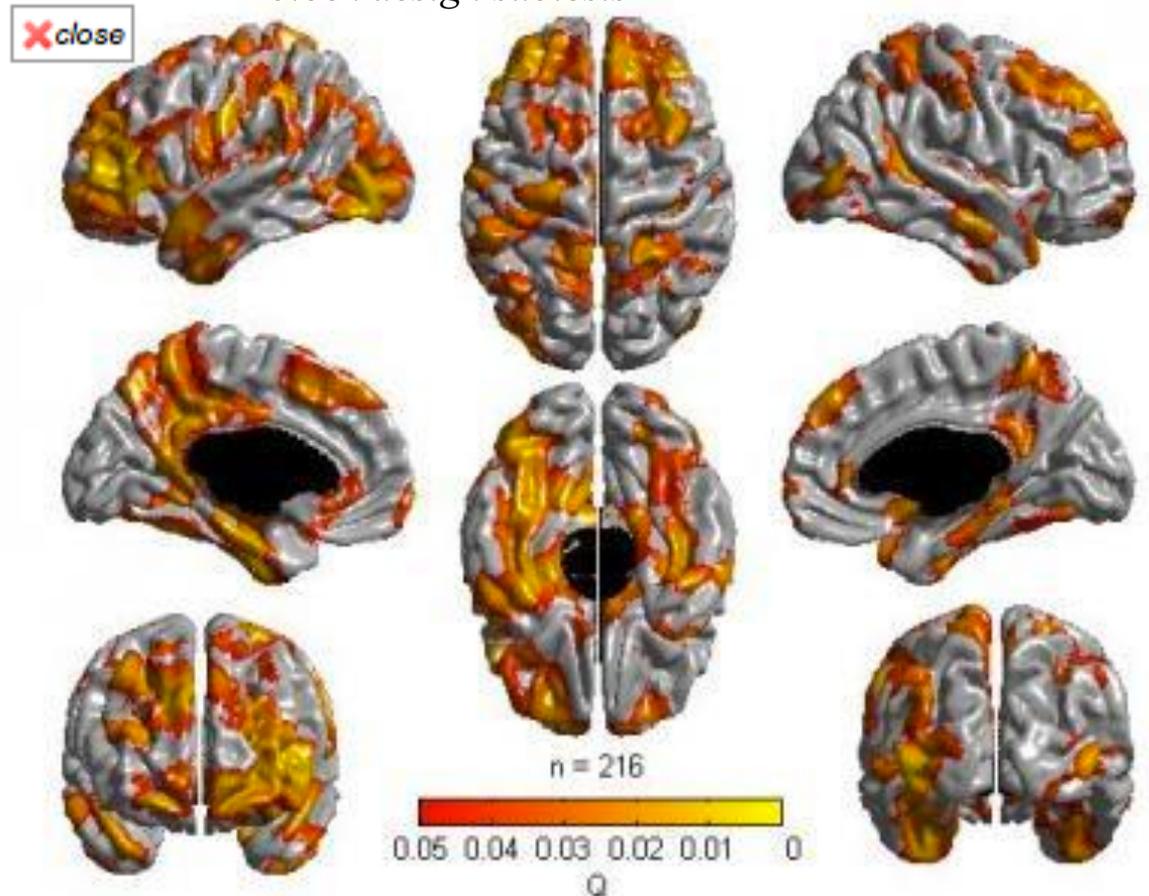
Positive association between cognitive ability and cortical thickness in a representative US sample of healthy 6 to 18 year-olds

Karama S^{1,*}, Ad-Dab'bagh Y¹, Haier RJ², Deary IJ³, Lyttelton OC¹, Lepage C¹, Evans AC¹, and Brain Development Cooperative Group⁴

¹McConnell Brain Imaging Centre, Montreal Neurological Institute, McGill University, Montreal,

A large sample of healthy children and adolescents (ages 6-18, N=216) representative of the US population were scanned with MRI and received Wechsler Abbreviated Scale of Intelligence (WASI) (Wechsler, 1999) administered to children ages 6 and older. Thus, the same test was used to measure intelligence across the age range analyzed in this paper. The WASI includes vocabulary, similarities, matrix reasoning, and block design subtests

Significant positive associations were evidenced between the cognitive ability factor and cortical thickness in most multimodal association areas. Results are consistent with a distributed model of intelligence





An fMRI study of nonverbally gifted reading disabled adults: has deficit compensation effected gifted potential?

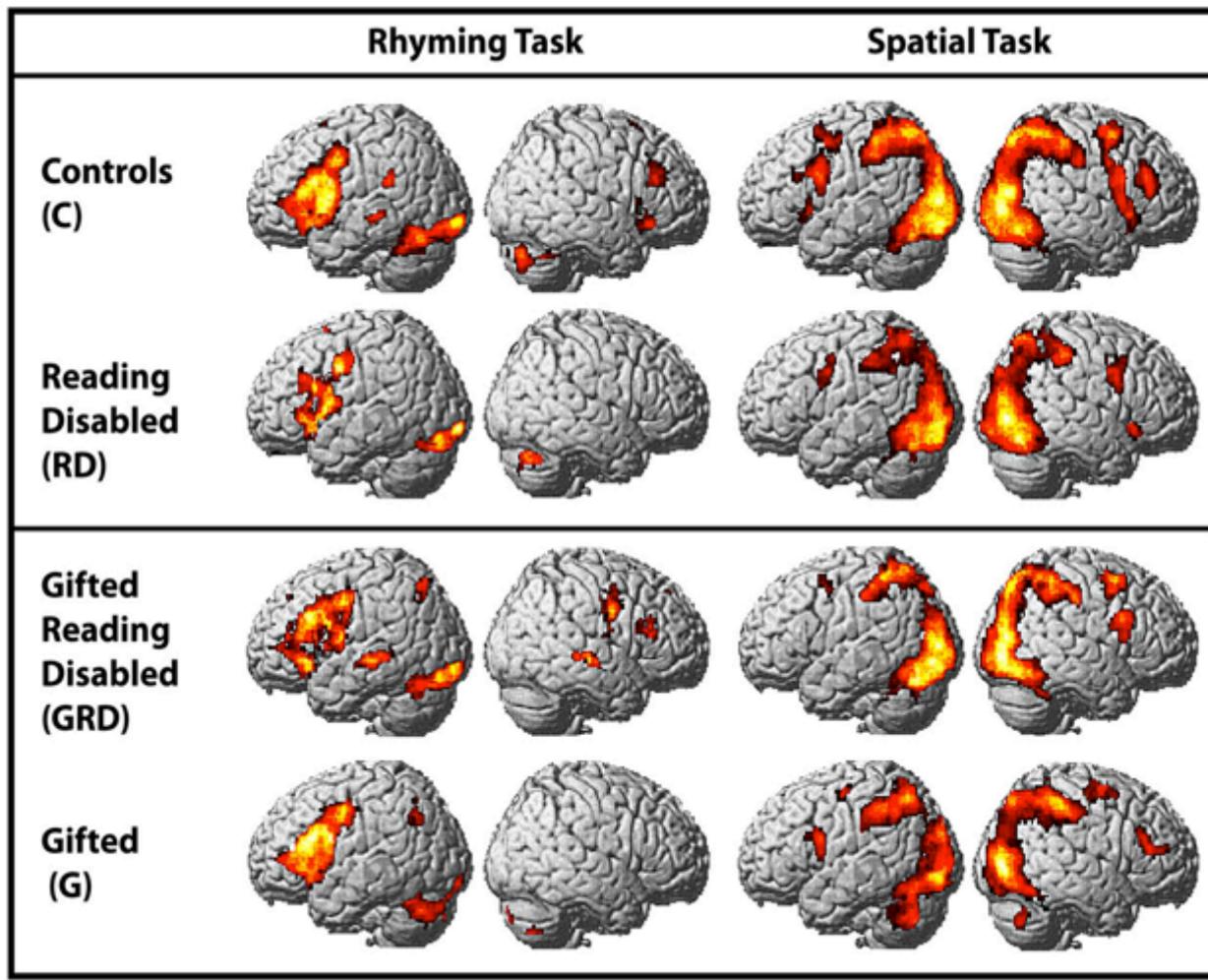
Jeffrey W. Gilger^{1*}, Thomas M. Talavage^{2,3} and Olumide A. Olulade^{3,4}

¹ Psychological Sciences, University of California Merced, Merced, CA, USA

² Weldon School of Biomedical Engineering, Purdue University, West Lafayette, IN, USA

³ The School of Electrical and Computer Engineering, Purdue University, West Lafayette, IN, USA

⁴ Center for the Study of Learning, Department of Pediatrics, Georgetown University Medical Center, Washington, DC, USA



non-verbally gifted RD adults resemble non-gifted RD adults in their performance on paper- and-pencil reading, math and spatial tests, and in their patterns of functional activation during reading and spatial processing. In our opinion, a shared etiology of RD and giftedness can yield a lifespan interaction with reading compensation effects modifying how an adult brain processes text and spatial stimuli.

Global connectivity of prefrontal cortex predicts cognitive control and intelligence

Michael W. Cole, Tal Yarkoni, Grega Repovs, Alan Anticevic, and Todd S. Braver

A lateral prefrontal cortex (LPFC) region’s activity was found to predict performance in a high control demand working memory task, and also to exhibit high global connectivity. Critically, global connectivity in this LPFC region, involving connections both within and outside the fronto-parietal network, showed a highly selective relationship with individual differences in fluid intelligence.

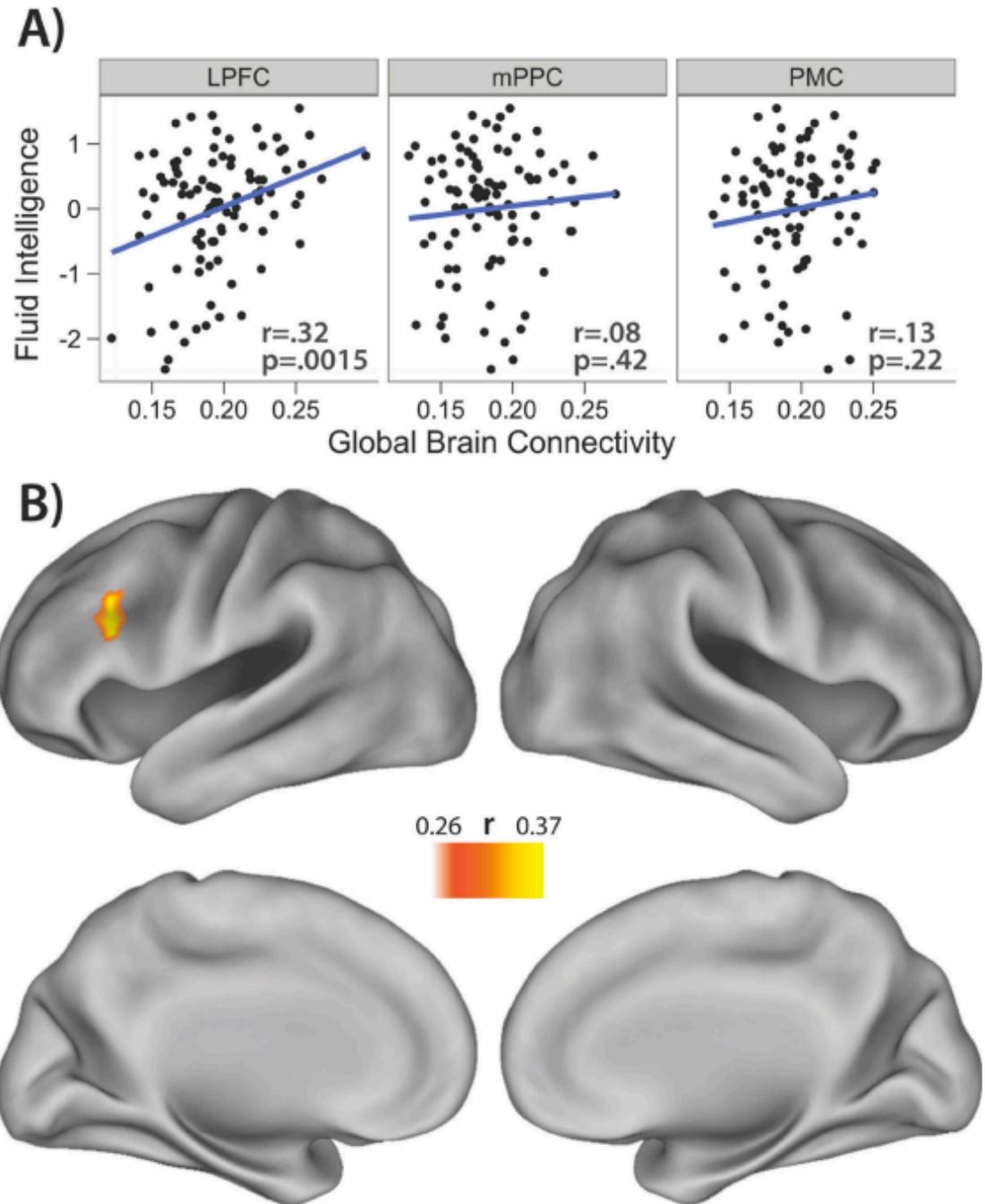
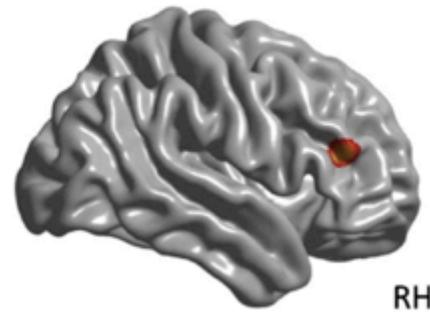
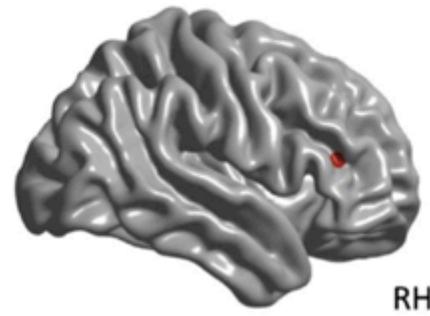


Figure 2. Global brain connectivity (GBC) correlations with general fluid intelligence (gF). **A)**

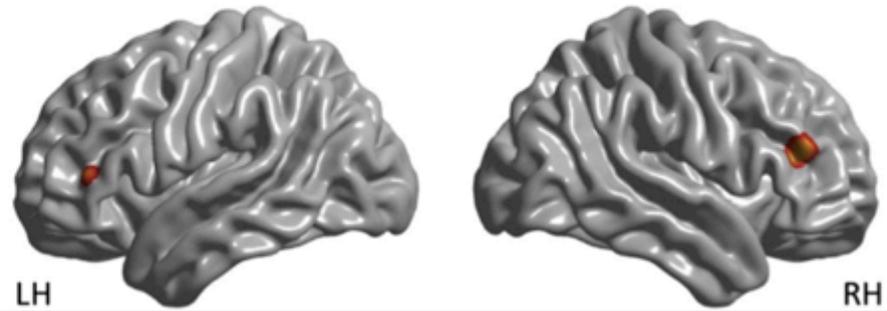
Fluid intelligence



Crystallized intelligence



Working memory capacity



P

0

0.0002

0.0004

0.0006

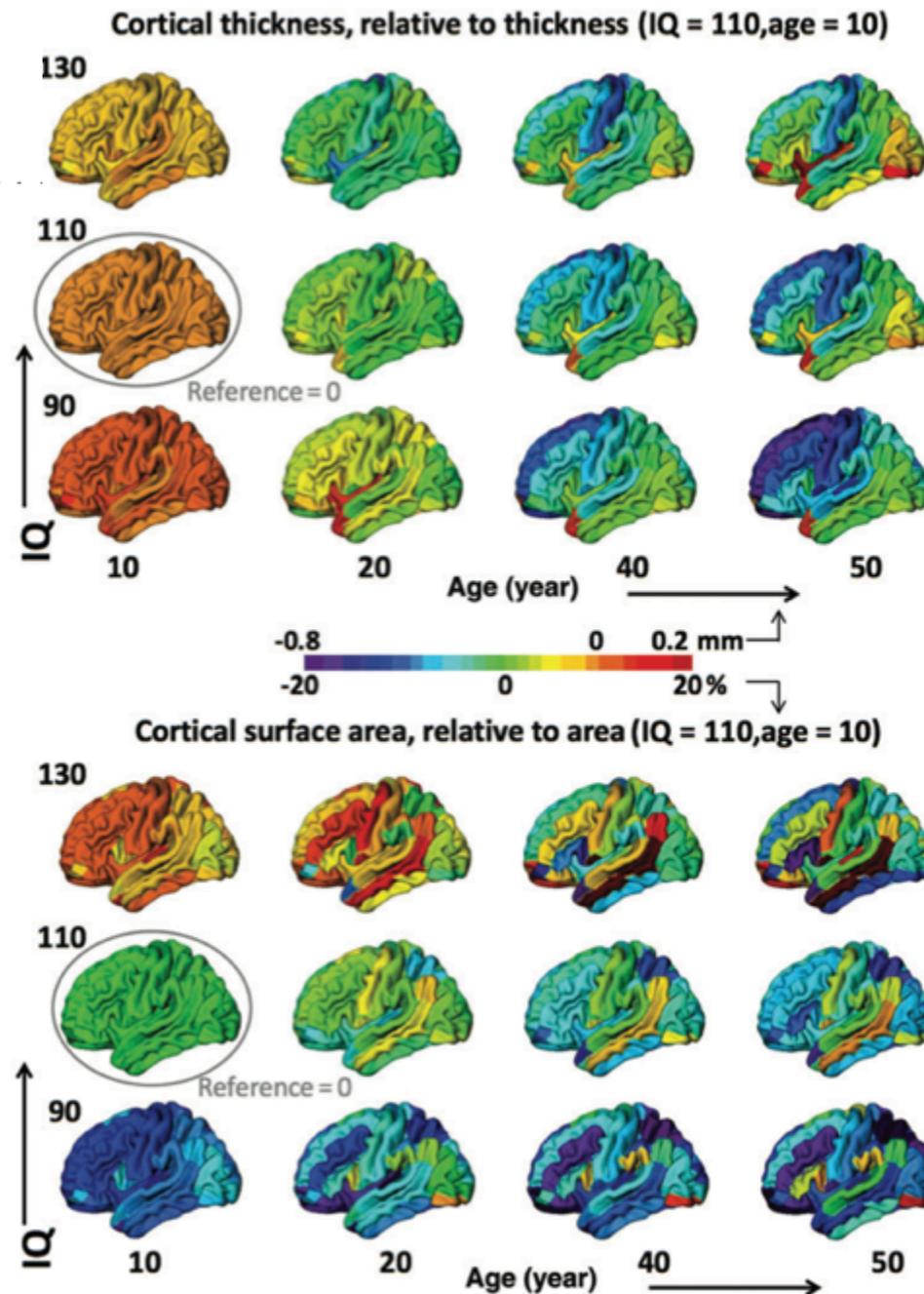
0.0008

0.001

Changes in Thickness and Surface Area of the Human Cortex and Their Relationship with Intelligence

Hugo G. Schnack¹, Neeltje E.M. van Haren¹, Rachel M. Brouwer¹, Alan Evans², Sarah Durston¹, Dorret I. Boomsma³, René S. Kahn¹ and Hilleke E. Hulshoff Pol¹

At 10 years of age, more intelligent children have a slightly thinner cortex than children with a lower IQ. This relationship becomes more pronounced with increasing age: with higher IQ, a faster thinning of the cortex is found over time. In the more intelligent young adults, this relationship reverses so that by the age of 42 a thicker cortex is associated with higher intelligence. In contrast, cortical surface is larger in more intelligent children at the age of 10. The cortical surface is still expanding, reaching its maximum area during adolescence. With higher IQ, cortical expansion is completed at a younger age; and once completed, surface area decreases at a higher rate.



of left cortical thickness (top) and surface area (bottom) with age (from left to right: 10, 20, 40, and 50 years) for 3 selected IQ values (rows: 130, 110, 90). Values (in mm) are relative to those for IQ = 110 at age 10 ("Reference = 0"), which consequently has value zero everywhere on the cortex. All surface area

Cognitive ability changes and dynamics of cortical thickness development in healthy children and adolescents

Miguel Burgaleta ^{a,b}, Wendy Johnson ^c, Deborah P. Waber ^{d,1}, Roberto Colom ^{a,e}, Sherif Karama ^{f,g,*}

Full Scale IQ (FSIQ), Performance IQ (PIQ) and Verbal IQ (VIQ) in a representative sample of children and adolescents (n = 188, mean age = 11.59 years) assessed two years apart as part of the NIH Study of Normal Brain Development.

changes in FSIQ, PIQ, and VIQ were related to rates of cortical thinning, mainly in left frontal areas. Participants who showed reliable gains in FSIQ showed no significant changes in cortical thickness on average, whereas those who exhibited no significant FSIQ change showed moderate declines in cortical thickness. Importantly, individuals who showed large decreases in FSIQ displayed the steepest and most significant reductions in cortical thickness.

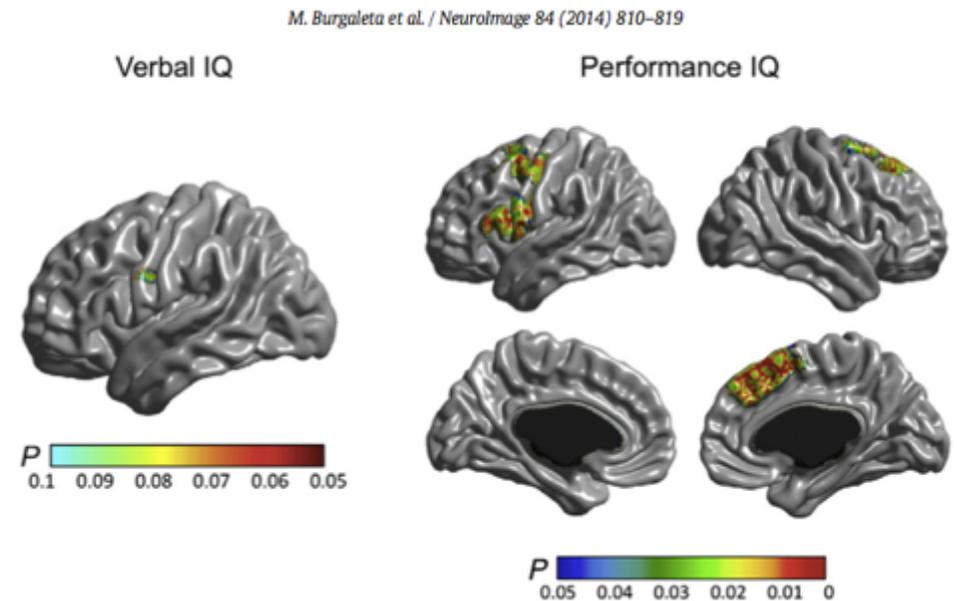
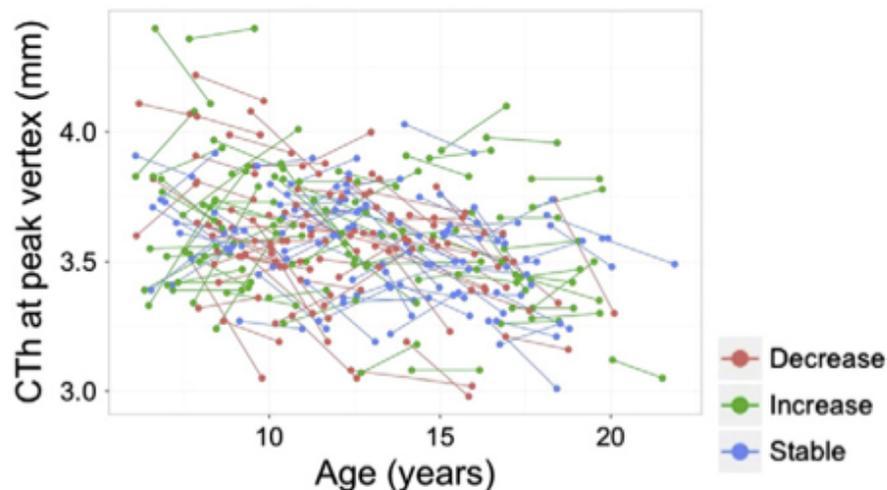


Fig. 6. Correlations between change in CTh and change in verbal IQ (left), and performance IQ (right).

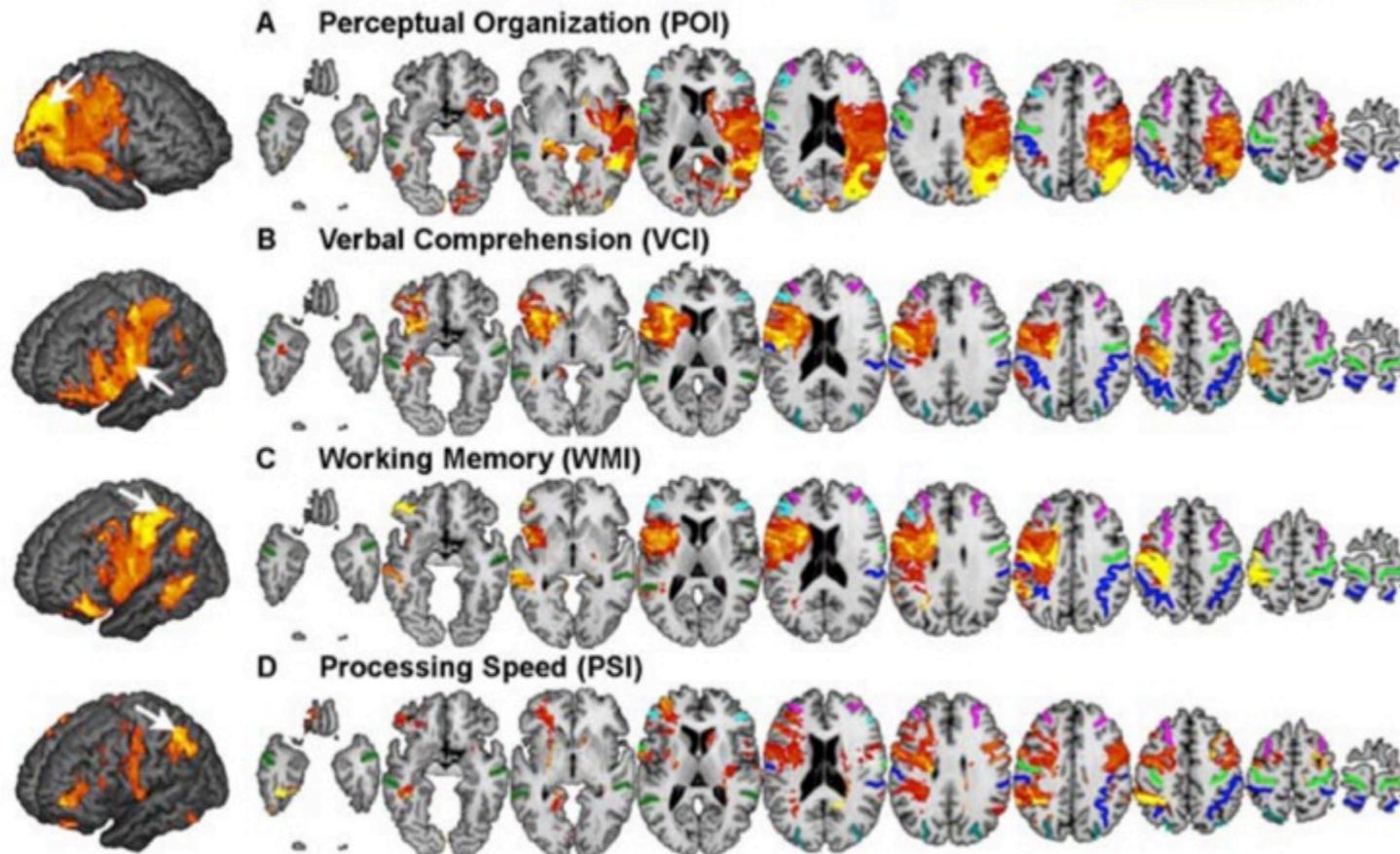
Lesion Mapping of Cognitive Abilities Linked to Intelligence

Jan Gläscher¹, Daniel Tranel³, Lynn K. Paul¹, David Rudrauf³, Chris Rorden⁴, Amanda Hornaday³, Thomas Grabowski³, Hanna Damasio^{5,3}, and Ralph Adolphs^{1,2,3}

¹ Division of Humanities and Social Sciences, Caltech, Pasadena, CA

voxel-based lesion- symptom mapping in 241 patients with focal brain damage to investigate their neural underpinnings. Statistically significant lesion-deficit relationships were found in left inferior frontal cortex for VCI, in left frontal and parietal cortex for WMI, and in right parietal cortex for POI. There was no reliable single localization for PSI.

Voxel-based lesion symptom mapping of four cognitive indices of intelligence. Our VLSM analyses compared the index scores for patients with a lesion against those without a lesion, at each and every voxel. All colored regions in the slice-wise display and the 3D projection (left; search depth 8 mm) survived a statistical threshold of 1% FDR. The size of the effect (greater Z-values) is color-coded with warmer colors corresponding to a greater difference. The graphs on the right show the mean difference on each index score between those patients whose lesions included the voxel showing the maximum effect (black arrow on the 3D projection) and those whose lesions did not include it (errorbar = s.e.m.). (a) perceptual organization (b) verbal comprehension, (c) working memory, (d) processing speed.



Distributed neural system for general intelligence revealed by lesion mapping

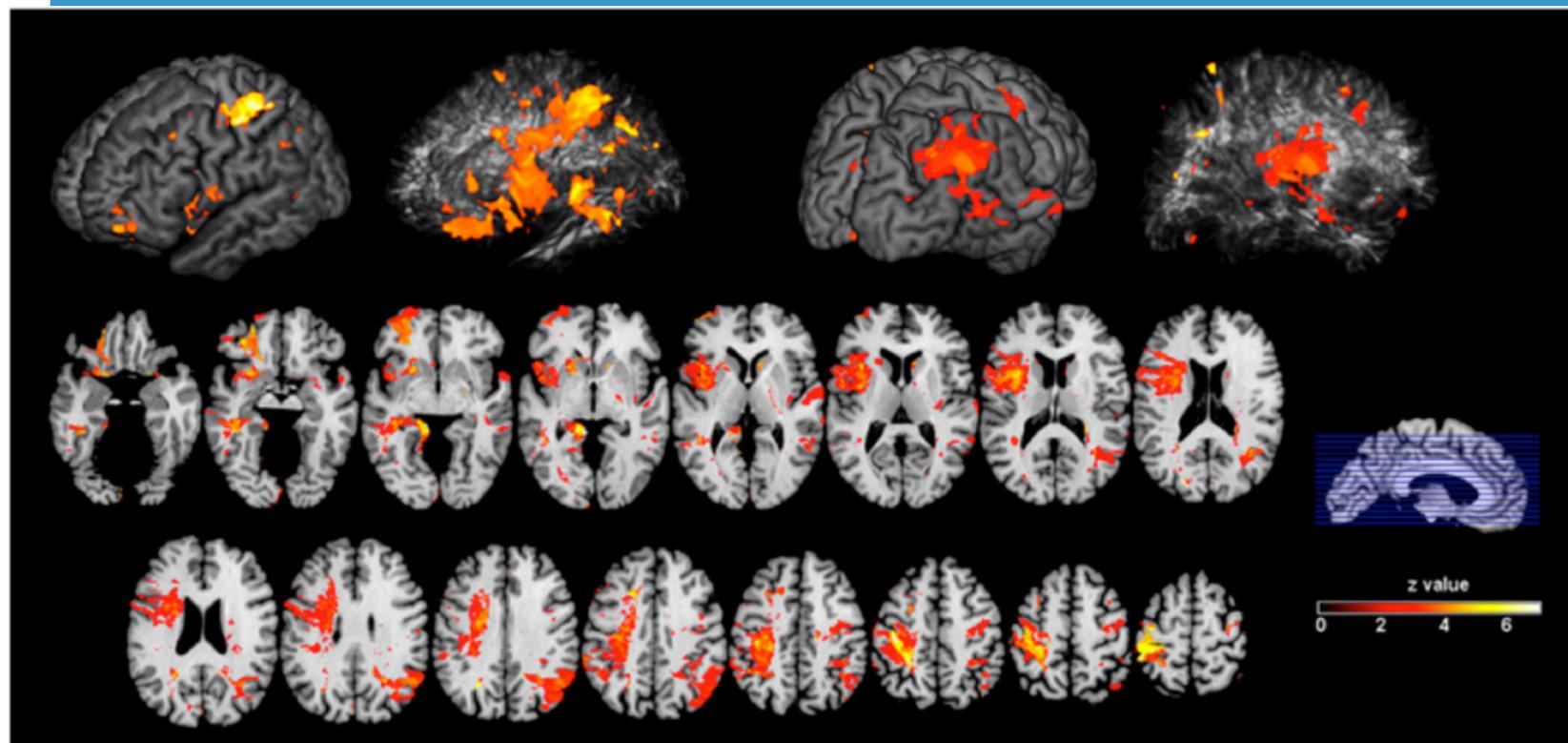
J. Gläscher^{a,b,1}, D. Rudrauf^{c,d}, R. Colom^e, L. K. Paul^a, D. Tranel^c, H. Damasio^f, and R. Adolphs^{a,g}

^aDivision of Humanities and Social Sciences, California Institute of Technology, Pasadena, CA 91125; ^bNeuroimage Nord, Department of Systems Neurology, University Medical Center Hamburg-Eppendorf, 20246 Hamburg, Germany; ^cDepartment of Neurology and ^dLaboratory of Brain Imaging and Cognitive Neuroscience, University of Iowa, Iowa City, IA 52242; ^eUniversidad Autonoma de Madrid, 28049 Madrid, Spain; ^fDornsife Cognitive Neuroscience Center and Brain and Creativity Institute, University of Southern California, Los Angeles, CA 90089; and ^gDivision of Biology, California Institute of Technology, Pasadena, CA 91125

Edited by Edward E. Smith, Columbia University, New York, NY, and approved January 25, 2010 (received for review September 10, 2009)

we investigated the neural substrates of g in 241 patients with focal brain damage using voxel-based lesion-symptom mapping. A hierarchical factor analysis across multiple cognitive tasks was used to derive a robust measure of g.

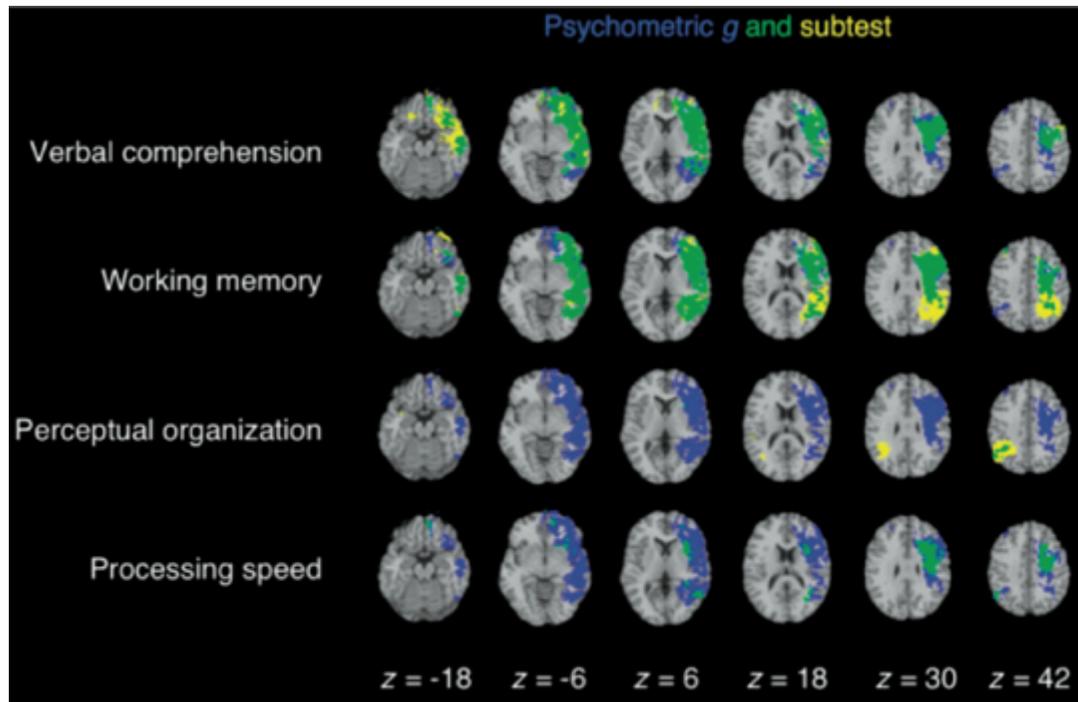
Statistically significant associations were found between g and damage to a remarkably circumscribed albeit distributed network in frontal and parietal cortex, critically including white matter association tracts and frontopolar cortex.



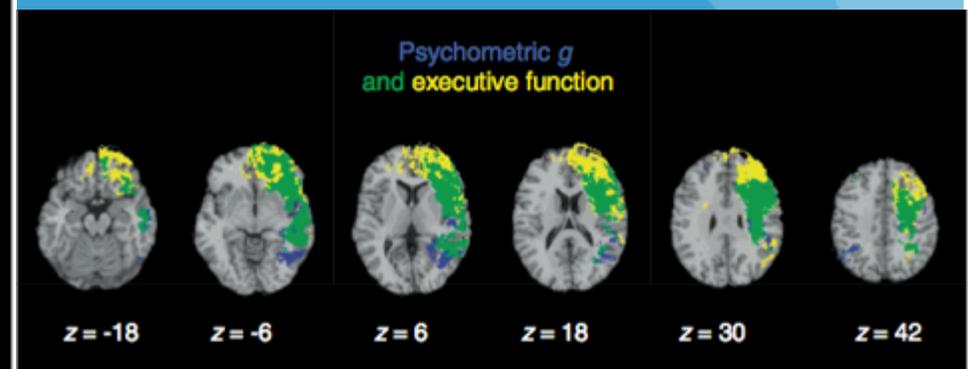
Lesion mapping of g. 3D renderings show cortical and subcortical regions with a statistically significant relationship between lesion location and g (corrected at 5% FDR). Axial slices are shown for a more detailed inspection.

An integrative architecture for general intelligence and executive function revealed by lesion mapping

Aron K. Barbey,^{1,2,3,4,5} Roberto Colom,⁶ Jeffrey Solomon,⁷ Frank Krueger,⁸ Chad Forbes⁹ and Jordan Grafman¹⁰



The information processing architecture of general intelligence, therefore, remains the focus of ongoing research and debate, with investigators proposing that psychometric *g* embodies a single cognitive ability implemented within processing networks of the prefrontal cortex (Duncan et al., 2000; Duncan, 2010) or derives instead from multiple cognitive operations that engage a distributed system of functionally specialized cortical regions (



We observed a significant effect on *g* and executive function with lesions in left hemispheric white matter sectors, including the superior longitudinal/arcuate fasciculus, which connect frontal and parietal cortices. Despite its distributed nature, the neural sub- strates of *g* and executive function were remarkably circumscribed, concentrated in the core of white matter and comprising a narrow subset of regions associated with performance on individual WAIS and D-KEFS subtests.