Quelles sont les découvertes sur le cerveau que les directions d'établissements scolaires devraient connaître?

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Manoir Saint-Sauveur - 7 mai 2015

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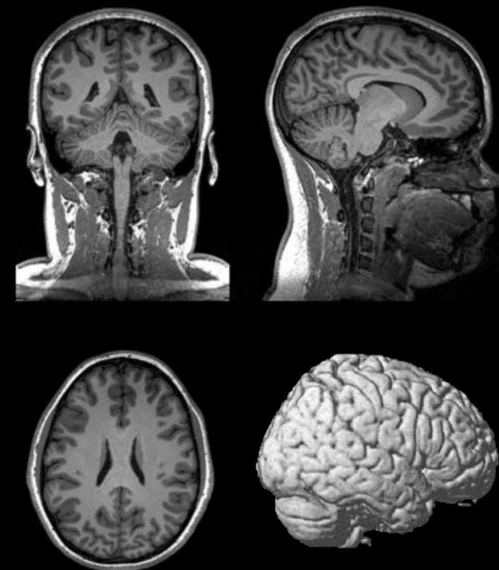

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University of California San Francisco

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Unité de neuroimagerie fonctionnelle de Montréal

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Quelles sont les découvertes sur le cerveau que les directions d'établissements scolaires devraient connaître?

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Découverte 1

Nos intuitions sur le fonctionnement du cerveau sont parfois erronées.

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Neuromythe 1
Styles d'apprentissage

Les personnes apprennent mieux
quand ils reçoivent l'information
dans leur style d'apprentissage préféré
(auditif, visuel, kinesthésique, etc.).

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Pashler, McDaniel, Rohrer et Bjork (2008)

PSYCHOLOGICAL SCIENCE IN THE PUBLIC INTEREST

Learning Styles

Concepts and Evidence

Harold Pashler,[1] Mark McDaniel,[2] Doug Rohrer,[3] and Robert Bjork[4]

[1]University of California, San Diego, [2]Washington University in St. Louis, [3]University of South Florida, and [4]University of California, Los Angeles

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Pashler, McDaniel, Rohrer et Bjork (2008)

Our review of the literature disclosed ample evidence that children and adults will, if asked, express preferences about how they prefer information to be presented to them. There is also plentiful evidence arguing that people differ in the degree to which they have some fairly specific aptitudes for different kinds of thinking and for processing different types of information. However, we found virtually no evidence for the interaction pattern mentioned above, which was judged to be a precondition for validating the educational applications of learning styles. Although the literature on learning styles is enormous, very few studies have even used an experimental methodology capable of testing the validity of learning styles applied to education. Moreover, of those that did use an appropriate method, several found results that flatly contradict the popular meshing hypothesis.

We conclude therefore, that at present, there is no adequate evidence base to justify incorporating learning-styles assessments into general educational practice. Thus, limited education resources would better be devoted to adopting other educational practices that have a strong evidence base, of which there are an increasing number.

p. 105

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Landrum et McDuffie (2010)

Learning Styles in the Age of Differentiated Instruction

Timothy J. Landrum and Kimberly A. McDuffie
University of Virginia

The concept of learning styles has tremendous logical and intuitive appeal, and educators' desire to focus on learning styles is understandable. Recently, a growing emphasis on differentiated instruction may have further increased teachers' tendency to look at learning styles as an instructionally relevant variable when individualizing instruction in increasingly heterogeneous classrooms. We discuss the overlapping concepts of individualized instruction and differentiated instruction, briefly review the evidence base for learning styles, and argue that instruction should indeed be individualized and differentiated. We conclude that there is insufficient evidence, however, to support learning styles as an instructionally useful concept when planning and delivering appropriately individualized and differentiated instruction.

p. 6

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Neuromythe 2
Dominance hémisphérique

Les différences au niveau de la dominance hémisphérique (cerveau gauche, cerveau droit) peuvent expliquer les différences entre les apprenants.

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Nielson et al. (2013)

OPEN ACCESS Freely available online — PLOS ONE

An Evaluation of the Left-Brain vs. Right-Brain Hypothesis with Resting State Functional Connectivity Magnetic Resonance Imaging

Jared A. Nielsen[1*], Brandon A. Zielinski[2], Michael A. Ferguson[3], Janet E. Lainhart[4], Jeffrey S. Anderson[1,3,5,6]

1 Interdepartmental Program in Neuroscience, University of Utah, Salt Lake City, Utah, United States of America, 2 Departments of Pediatrics and Neurology, University of Utah, Salt Lake City, Utah, United States of America, 3 Department of Bioengineering, University of Utah, Salt Lake City, Utah, United States of America, 4 Waisman Laboratory for Brain Imaging and Behavior, Department of Psychiatry, Division of Child & Adolescent Psychiatry, University of Wisconsin, Madison, Wisconsin, United States of America, 5 Department of Radiology, University of Utah, Salt Lake City, Utah, United States of America, 6 The Brain Institute at the University of Utah, Salt Lake City, Utah, United States of America

Abstract

Lateralized brain regions subserve functions such as language and visuospatial processing. It has been conjectured that individuals may be left-brain dominant or right-brain dominant based on personality and cognitive style, but neuroimaging data has not provided clear evidence whether such phenotypic differences in the strength of left-dominant or right-dominant networks exist. We evaluated whether strongly lateralized connections covaried within the same individuals. Data were analyzed from publicly available resting state scans for 1011 individuals between the ages of 7 and 29. For each subject, functional lateralization was measured for each pair of 7266 regions covering the gray matter at 5-mm resolution as a difference in correlation before and after inverting images across the midsagittal plane. The difference in gray matter density between homotopic coordinates was used as a regressor to reduce the effect of structural asymmetries on functional lateralization. Nine left- and 11 right-lateralized hubs were identified as peaks in the degree map from the graph of significantly lateralized connections. The left-lateralized hubs included regions from the default mode network (medial prefrontal cortex, posterior cingulate cortex, and temporoparietal junction) and language regions (e.g., Broca Area and Wernicke Area), whereas the right-lateralized hubs included regions from the attention control network (e.g., lateral intraparietal sulcus, anterior insula, area MT, and frontal eye fields). Left- and right-lateralized hubs formed two separable networks of mutually lateralized regions. Connections involving only left- or only right-lateralized hubs showed positive correlation across subjects, but only for connections sharing a node. Lateralization of brain connections appears to be a local rather than global property of brain networks, and our data are not consistent with a whole-brain phenotype of greater "left-brained" or greater "right-brained" network strength across individuals. Small increases in lateralization with age were seen, but no differences in gender were observed.

Conclusion de l'étude : « nos données ne sont pas compatibles avec l'idée que certaines personnes sont plus "cerveau gauche", alors que d'autres sont plus "cerveau droit". » (p. 27)

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Neuromythe 3
Exercices de coordination et Brain Gym

De courtes séances d'exercices de coordination peuvent améliorer l'intégration des fonctions des hémisphères gauche et droit du cerveau.

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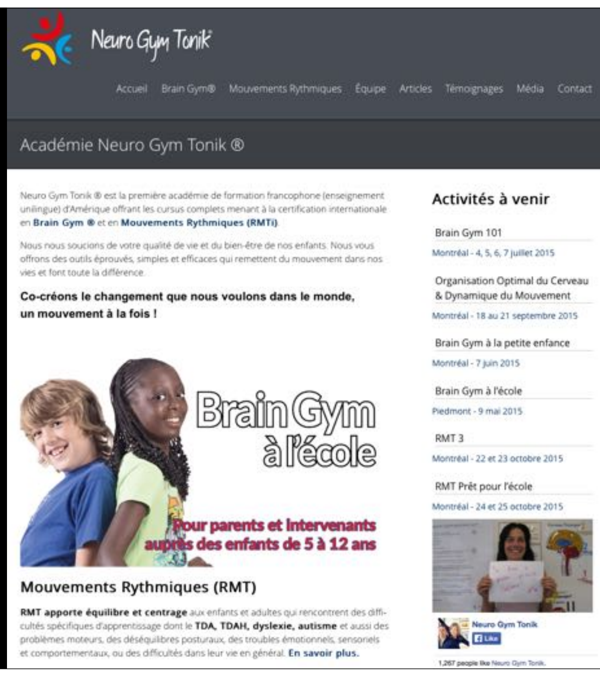

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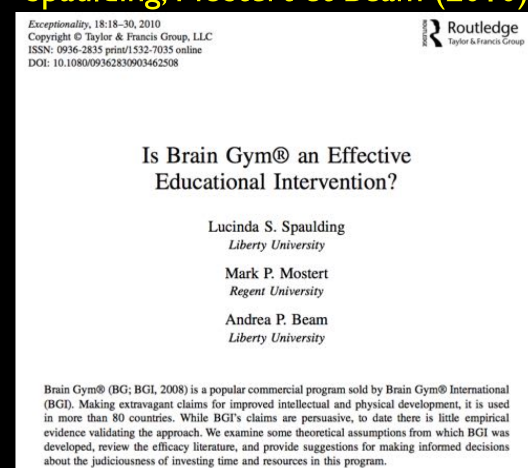
Spaulding, Mostert et Beam (2010)



Exceptionality, 18:18–30, 2010
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DOI: 10.1080/09362830903462508

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Is Brain Gym® an Effective Educational Intervention?

Lucinda S. Spaulding
Liberty University

Mark P. Mostert
Regent University

Andrea P. Beam
Liberty University

Brain Gym® (BG; BGI, 2008) is a popular commercial program sold by Brain Gym® International (BGI). Making extravagant claims for improved intellectual and physical development, it is used in more than 80 countries. While BGI's claims are persuasive, to date there is little empirical evidence validating the approach. We examine some theoretical assumptions from which BGI was developed, review the efficacy literature, and provide suggestions for making informed decisions about the judiciousness of investing time and resources in this program.

Conclusion de l'étude : « Brain Gym est fondé sur des hypothèses théoriques qui ont, depuis longtemps, été invalidées et il n'existe aucune recherche empirique de qualité validant ses prétentions » (p. 27)

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Hyatt (2007)

Brain Gym®

Building Stronger Brains or Wishful Thinking?

KEITH J. HYATT

ABSTRACT

As part of the accountability movement, schools are increasingly called upon to provide interventions that are based on sound scientific research and that provide measurable outcomes for children. Brain Gym® is a popular commercial program claiming that adherence to its regimen will result in more efficient learning in an almost miraculous manner. However, a review of the theoretical foundations of Brain Gym® and the associated peer-reviewed research studies failed to support the contentions of the promoters of Brain Gym®. Educators are encouraged to become informed consumers of research and to avoid implementing programming for which there is neither a credible theoretical nor a sound research basis.

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Masson (2015)

A.N.A.E., 2015; 134; 001-008 LES APPORTS DE LA NEUROÉDUCATION À L'ENSEIGNEMENT : DES NEUROMYTHES AUX DÉCOUVERTES ACTUELLES

Les apports de la neuroéducation à l'enseignement : des neuromythes aux découvertes actuelles

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Masson (2015)

Tableau 1. Neuromythes les plus fréquents chez les enseignants.

Neuromythe	Prévalence chez les enseignants					
	Royaume-Uni	Pays-Bas	Turquie	Grèce	Chine	Moyenne
Styles d'apprentissage Les élèves apprennent mieux lorsqu'ils reçoivent l'information dans leur style d'apprentissage préféré (ex. auditif, visuel ou kinesthésique)	93 %	96 %	97 %	96 %	97 %	96 %
Dominance hémisphérique Des différences de dominance hémisphérique (cerveau gauche ou cerveau droit) peuvent aider à expliquer les différences observées parmi les apprenants.	91 %	86 %	79 %	74 %	71 %	80 %
Exercices de coordination De courtes séances d'exercices de coordination peuvent améliorer l'intégration des fonctions des hémisphères gauche et droit du cerveau	88 %	82 %	72 %	60 %	84 %	77 %

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Dekker *et al.* (2012)

Table 3 | Predictors of neuromyths.

	B (SE)	*t*	*p*	95% CI for *B*	
				Lower	Upper
Intercept	0.250 (0.067)	3.73	0.000	0.118	0.382
Country	−0.001 (0.020)	−0.072	0.943	−0.041	0.038
Age	0.002 (0.001)	1.75	0.082	0.000	0.003
Gender	0.030 (0.021)	1.43	0.155	−0.011	0.071
Teacher	−0.024 (0.019)	−1.27	0.206	−0.061	0.013
Read popular science	0.006 (0.024)	0.256	0.798	−0.041	0.053
Read scientific journals	−0.024 (0.026)	−0.940	0.348	−0.075	0.027
In-service training	−0.002 (0.020)	−0.078	0.938	−0.040	0.037
Knowledge (% correct)	0.240 (0.071)	3.39	0.001*	0.100	0.379

*$p < 0.001$.

Les enseignants ayant le plus de connaissances sur le cerveau sont aussi ceux qui ont le plus de neuromythes!!!

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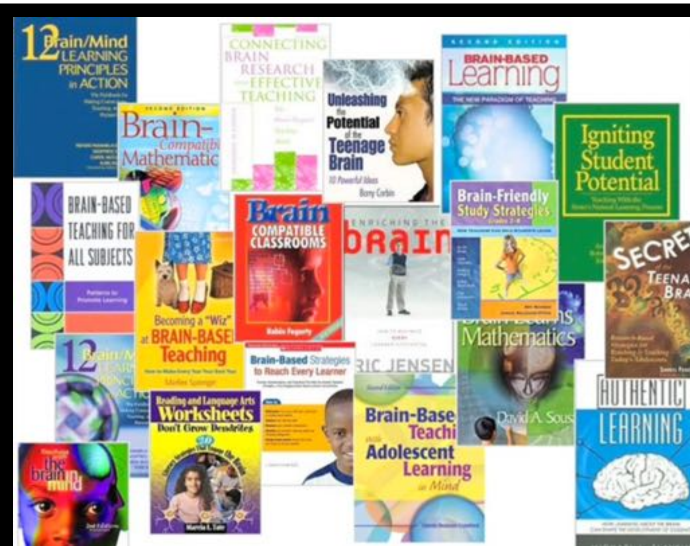
Dekker *et al.* (2012)

Table 4 | Predictors of general knowledge.

	B (SE)	t	p	95% CI for B	
				Lower	Upper
Intercept	0.678 (0.046)	14.631	0.000	0.587	0.769
Country	0.044 (0.02)	2.270	0.024*	0.006	0.083
Age	−0.001 (0.001)	−0.688	0.492	−0.002	0.001
Gender	−0.005 (0.021)	−0.238	0.812	−0.046	0.036
Teacher	−0.002 (0.019)	−0.122	0.903	−0.039	0.034
Read popular science	0.067 (0.023)	2.919	0.004**	0.022	0.113
Read scientific journals	0.002 (0.026)	0.065	0.948	−0.049	0.052
In-service training	0.035 (0.019)	1.814	0.071	−0.003	0.073

$^{*}p < 0.05$; $^{**}p < 0.01$.

Les neuromythes proviennent notamment des magazines et des livres populaires.



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labneuroeducation.org

Découverte 2

L’apprentissage modifie le cerveau.

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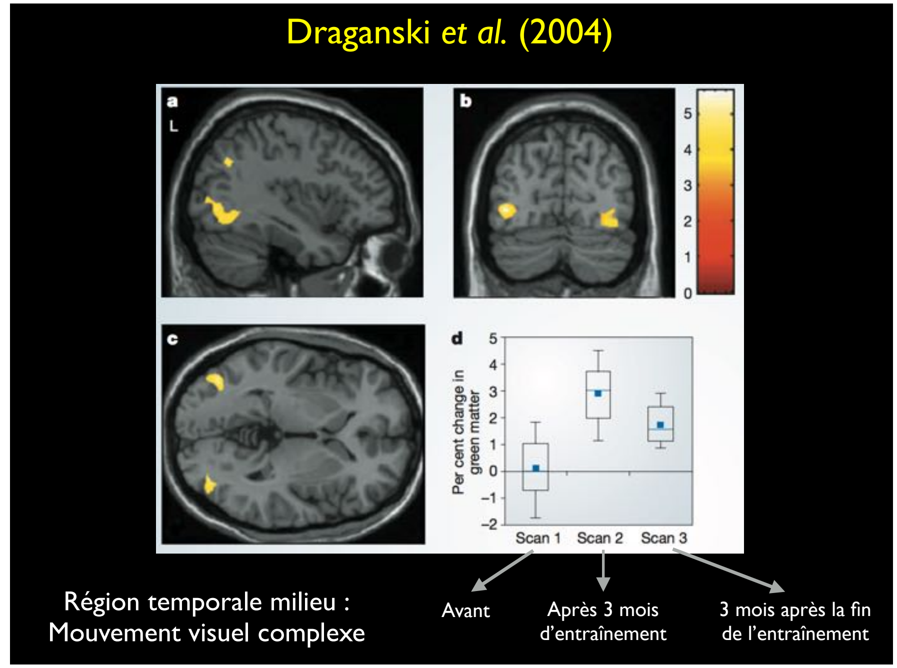
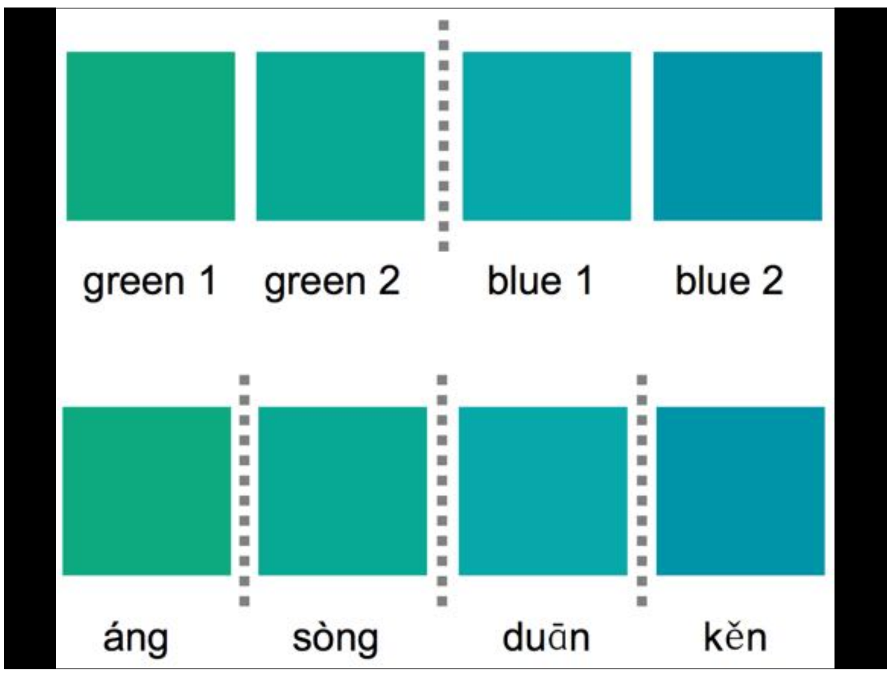

Draganski et al. (2004)
a
L
b
c
d
Per cent change in
green matter
Scan 1
Scan 2
Scan 3
Région temporale milieu :
Mouvement visuel complexe
Avant
Après 3 mois
d'entraînement
3 mois après la fin
de l'entraînement

26


green 1
green 2
blue 1
blue 2
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kěn

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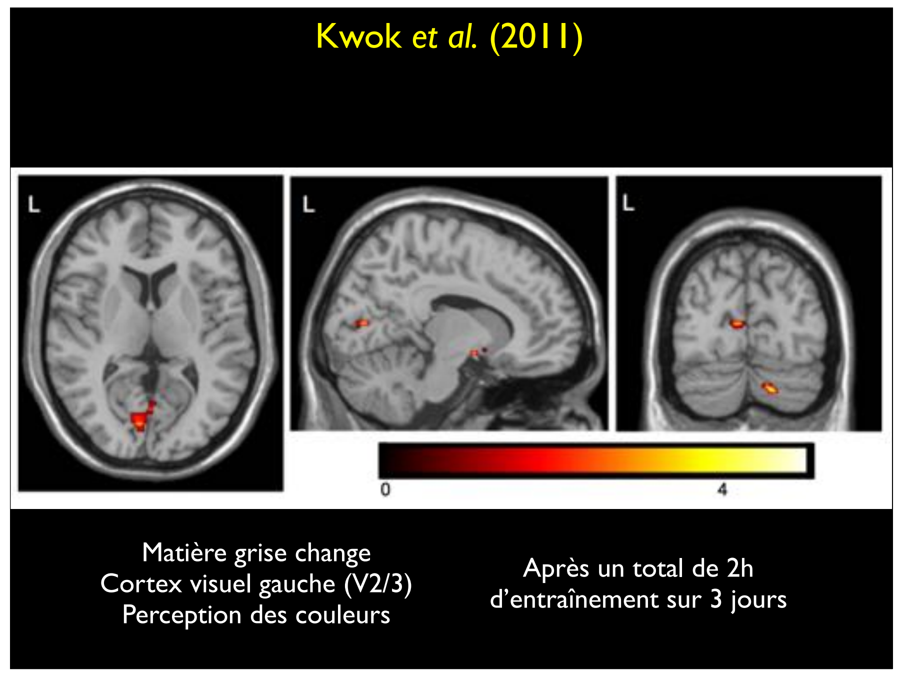
Kwok et al. (2011)
L
L
L
0
4
Matière grise change
Cortex visuel gauche (V2/3)
Perception des couleurs
Après un total de 2h
d'entraînement sur 3 jours

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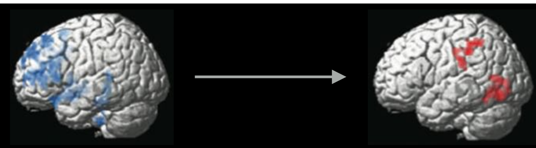
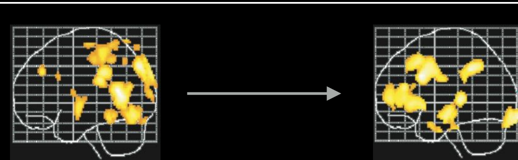
Apprentissage
de l'arithmétique



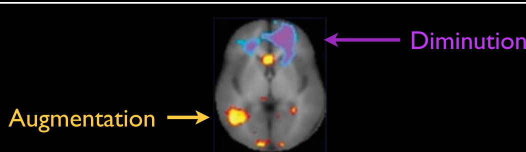
Rivera *et al.* (2005)

Apprentissage
du raisonnement



Houdé *et al.* (2000)

Apprentissage
de la lecture



Shaywitz *et al.* (2007)

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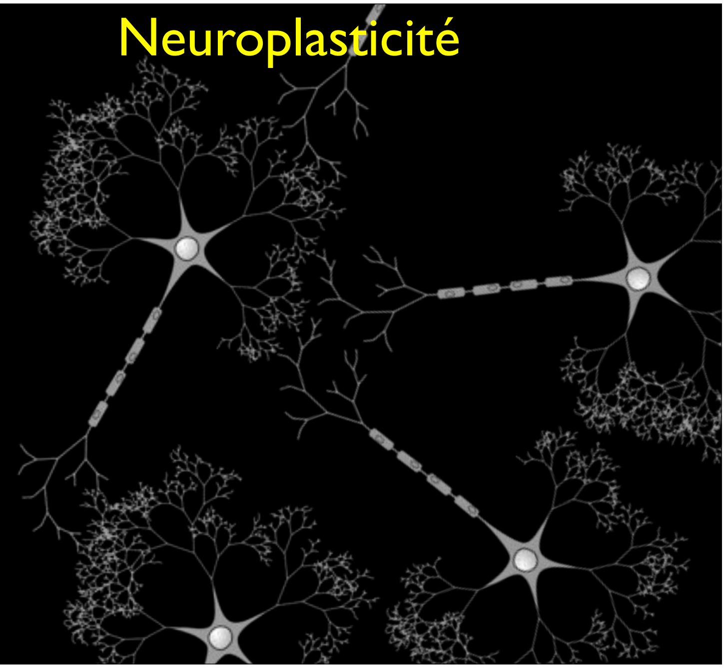
Neuroplasticité



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Neuroplasticité

Edward Ruthazer, McGill University
Code Chastenay, 9 octobre 2012

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<u>Découverte 3</u>

Le fonctionnement du cerveau influence l'apprentissage.

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Influence 1
Les mécanismes de neuroplasticité

Les neurones qui s'activent ensemble
se connectent ensemble (Hebb, 1949).

33

34

Recommandation 1 - Activation neuronale répétée

Activer à plusieurs reprises
les neurones liés à un apprentissage.

Comment?

- Tester : exercices, évaluations formatives, mini-tests, examen, etc.
- Montrer comment étudier (en se posant des questions à soi-même).
- Questionner, faire enseigner, interagir, etc.
- Proposer des tâches qui impliquent de mobiliser des savoirs spécifiques.
- ...

35

Le sommeil et les périodes de repos
consolident les apprentissages
en réactivant les mêmes réseaux neurones
que ceux impliqués lors de l'apprentissage
(ex. Antony et al., 2012).

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Recommandation 2 - Espacement

Espacer les périodes d’apprentissage.

Comment?

- Lors de la planification, répartir le temps alloué à un apprentissage (4 x 30 minutes plutôt que 1 x 2 heures).
- Éviter de regrouper les périodes d’enseignement allouées à un sujet donné.
- Revenir sur les contenus déjà appris.
- Donner des devoirs sur des contenus abordés.
- Montrer comment étudier : espacer les périodes d’études.
- ...

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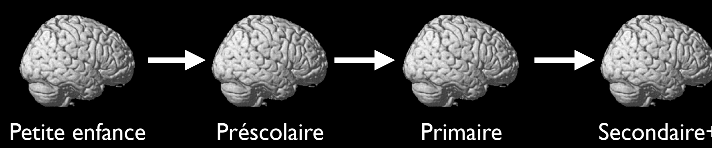
Influence 2
La structure initiale du cerveau

La structure initiale du cerveau joue un rôle déterminant dans les nouveaux apprentissages.



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Lecture

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L’exemple de la lecture

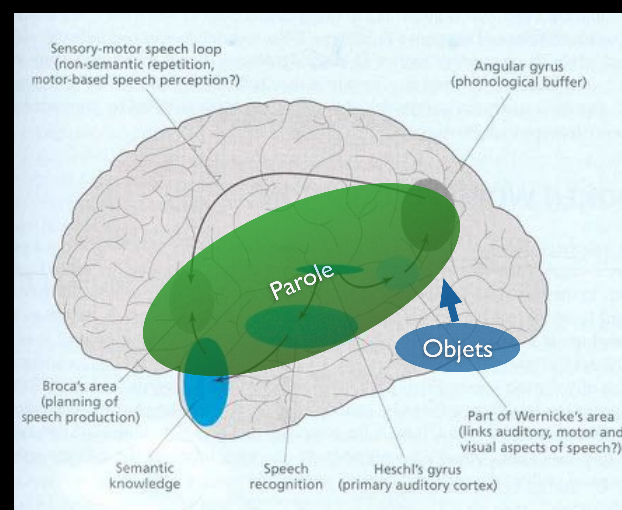


Figure adaptée de Ward (2006, p. 211)

40

Dehaene *et al.* (2002)

Le cortex <u>occipito-temporal gauche</u> est plus activé pour les mots écrits que pour les mots parlés chez les sept sujets.

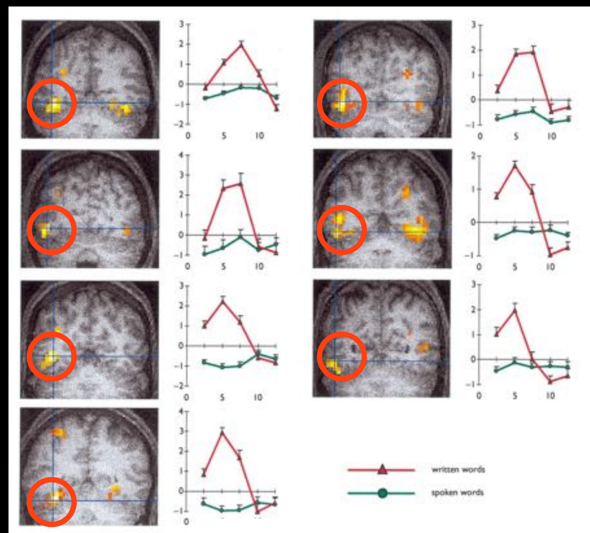
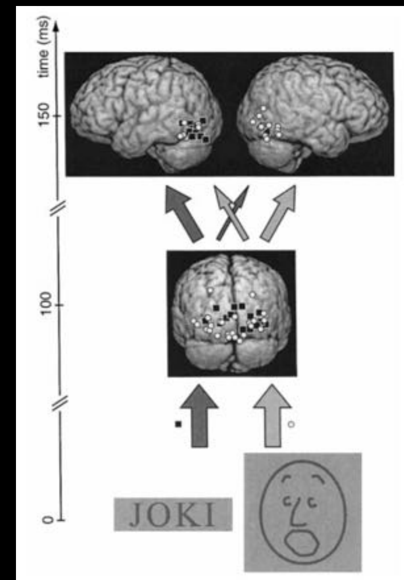


Fig. 2. Anatomical localization and modality-specificity of the visual word form area. In all seven subjects, an area of the left fusiform gyrus responded robustly to written words, but not to spoken words.

Tarkiainen, Cornelissen, & Salmelin (2002)

Région occipito-temporale gauche



Le cortex occipito-temporal et l'identification d'objets

Le cortex occipito-temporal et l'identification de lettres

d

Lettres difficiles à identifier

d b

q p

45

Calcul

46

Nombre non symbolique (sens des nombres)

47

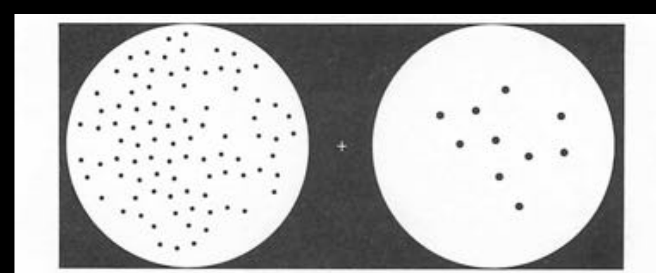


Figure tirée de Dehaene (2011, p. 238)

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Piazza et al. (2004)

Sillon intrapariétal

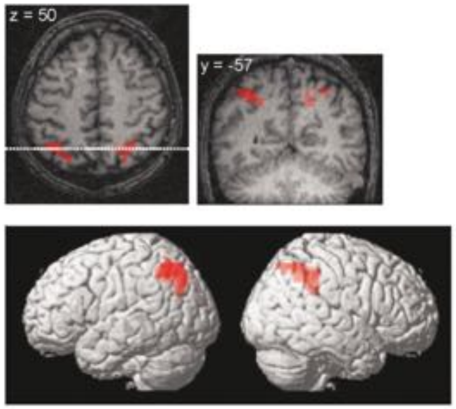
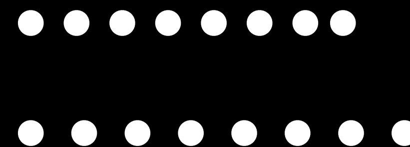


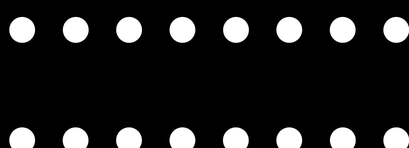
Figure 3. Brain Regions that Respond to Number Change

Brain regions that responded to number change superimposed on axial (top left) and coronal (top right) anatomical images of one subject, and on a standard 3D render of the cortex (bottom).

Relation nombre et espace



Relation nombre et espace



Houdé et al. (2012)

Sillon intrapariétal

Cortex préfrontal ventrolatéral (inhibition)

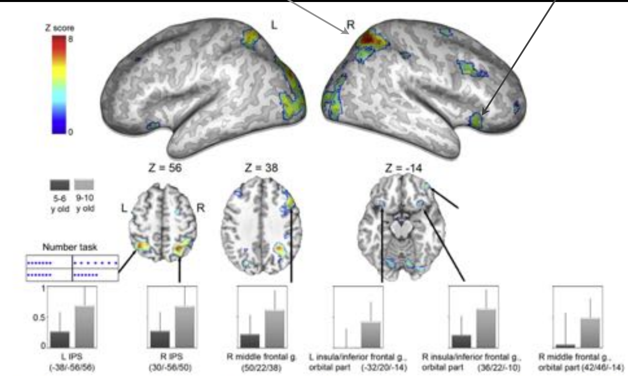


Fig. 4. 3D rendering of areas activated more in successful 9- and 10-year-olds (conservers) compared with unsuccessful 5- and 6-year-olds (nonconservers) during the Number task. Each plot represents the mean bold signal in the pointed cluster. L, left; R, right; frontal g., frontal gyrus.

9-10 ans (bonnes réponses) > 5-6 ans (mauvaises réponses)

Découverte 4
L'enseignement influence le fonctionnement du cerveau.

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Yoncheva *et al.* (2010)

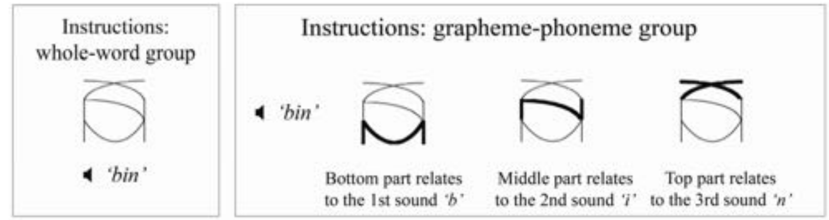

FIGURE 1. Manipulating attentional focus during training in artificial orthography. Participants were trained in either the whole-word condition or in the phoneme-grapheme condition. Training was identical for both groups (exactly the same visual characters and auditory words were presented), except for the instructional slide at the onset of training, which prescribed the use of one of two learning strategies. The grapheme-phoneme group was focused on linking the hidden letters with sounds within words, whereas the whole-word group was asked to associate whole visual characters with entire auditory words.

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Yoncheva *et al.* (2010)

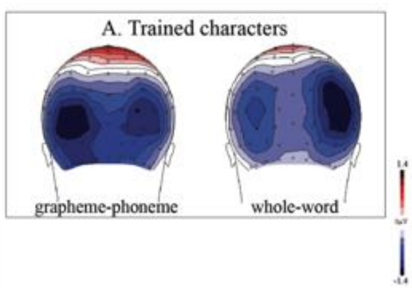

FIGURE 3 Topographic maps of the N170 ERP in response to (a) trained and (b) transfer characters in the reading verification task. The grapheme-phoneme group exhibits a predominantly left-lateralized topography over occipito-temporal regions relative to the right-lateralized topography of the whole-word group. (Figure is available in color online)

55

Yoncheva *et al.* (2010)

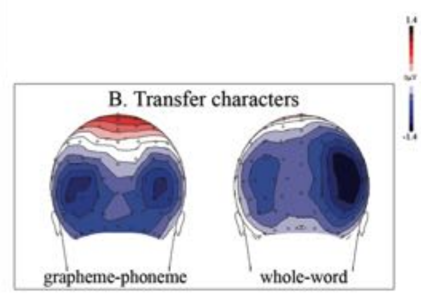

FIGURE 3 Topographic maps of the N170 ERP in response to (a) trained and (b) transfer characters in the reading verification task. The grapheme-phoneme group exhibits a predominantly left-lateralized topography over occipito-temporal regions relative to the right-lateralized topography of the whole-word group. (Figure is available in color online)

56

Houdé et al. (2001)

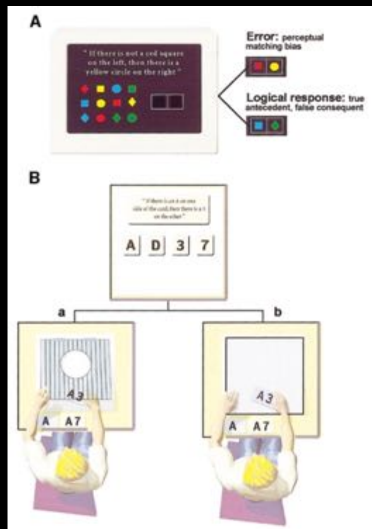

FIG. 1. Experimental design. (A) Pretest (PET 1) and posttest (PET 2) materials on the rule falsification task. (B) (a) Logicoemotional training in matching-bias inhibition; (b) training in logic only.

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Houdé et al. (2001)

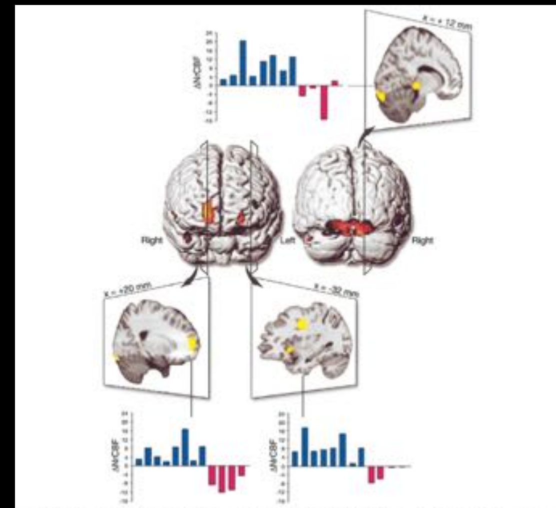

FIG. 2. Brain areas activated during the deductive reasoning task on the posttest (taking the pretest as a control) in the logic–emotion group only. Left: Frontal view of the brain template; Right: Posterior view. The selected sagittal slices (labeled with their stereotactic x coordinate in millimeters) show specific activations in the right ventromedial prefrontal cortex/anterior cingulate ($x = +20$), the left prefrontal cortex at the junction of the precentral gyrus and the middle frontal gyrus ($x = -32$), the right pulvinar, and the bilateral peristriate cortex ($x = +12$). For each region, the bar graphs show the average (three repetitions per test) NrCBF variations in each individual (blue, the eight subjects from the logic–emotion group; red, the four subjects from the logic-only group). Z maps were generated using SPM99 software by contrasting the logic–emotion group's and the logic-only group's NrCBF maps with a 4.6 Z threshold ($P < 0.05$, corrected for multiple comparisons).

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Conclusion

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Synthèse

- Découverte 1 : Nos intuitions sur le fonctionnement du cerveau sont parfois erronées.
- Découverte 2 : L'apprentissage influence le cerveau.
- Découverte 3 : Le fonctionnement du cerveau influence l'apprentissage
  - activation neuronale répétée
  - espacement
- Découvertes 4 : L'enseignement influence le fonctionnement du cerveau.

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Actions à entreprendre

- Action 1 : Faire connaître les neuromythes aux enseignants.
- Action 2 : Mieux former les enseignants sur le fonctionnement du cerveau.