Educational neuroscience: A teacher's guide to the good, the bad and the irrelevant

Dorothy Bishop

Wellcome Trust Principal Research Fellow, University of Oxford

@deevybee

Short videos re language impairment
https://www.youtube.com/RALLIcampaign

Publications (most are Open Access)
http://scholar.google.co.uk/citations?user=6nqXjKIAAAAJ&hl=en

Website
http://www.psy.ox.ac.uk/research/oxford-study-of-children-s-communication-impairments

Blog: http://deevybee.blogspot.co.uk/

Slideshare (articles and talks): http://www.slideshare.net/deevybishop

Educational neuroscience courses

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Brain scientists to work with schools on how to learn

By Sean Coughlan
BBC News education correspondent

A £6m fund has been launched to make better use of neuroscience in classrooms in England.

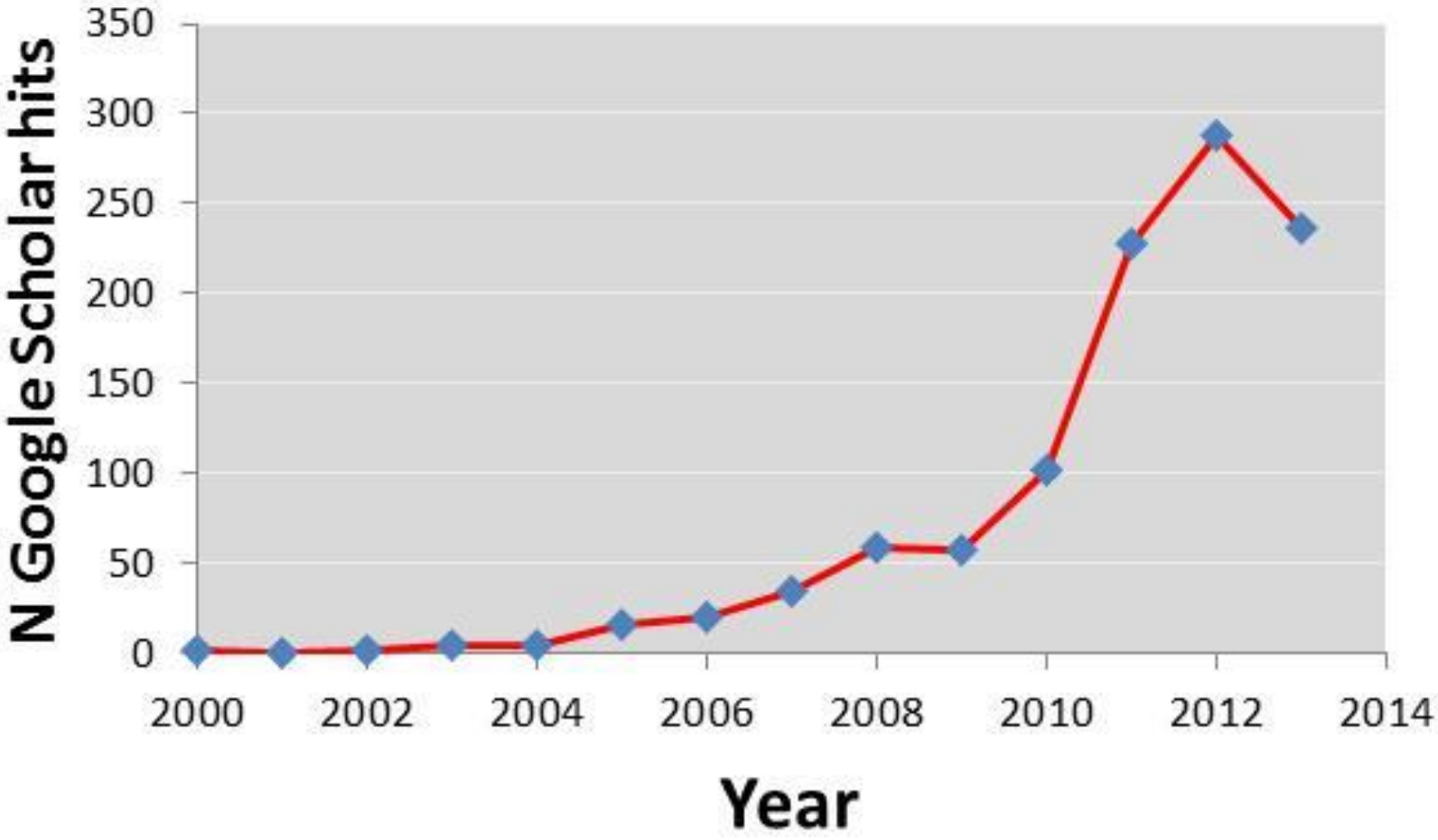
The scheme, backed by the Wellcome Trust and Education Endowment Foundation, wants more evidence-based research into how schoolchildren's brains process information.

This could include how the brain's performance is damaged by sleep loss.

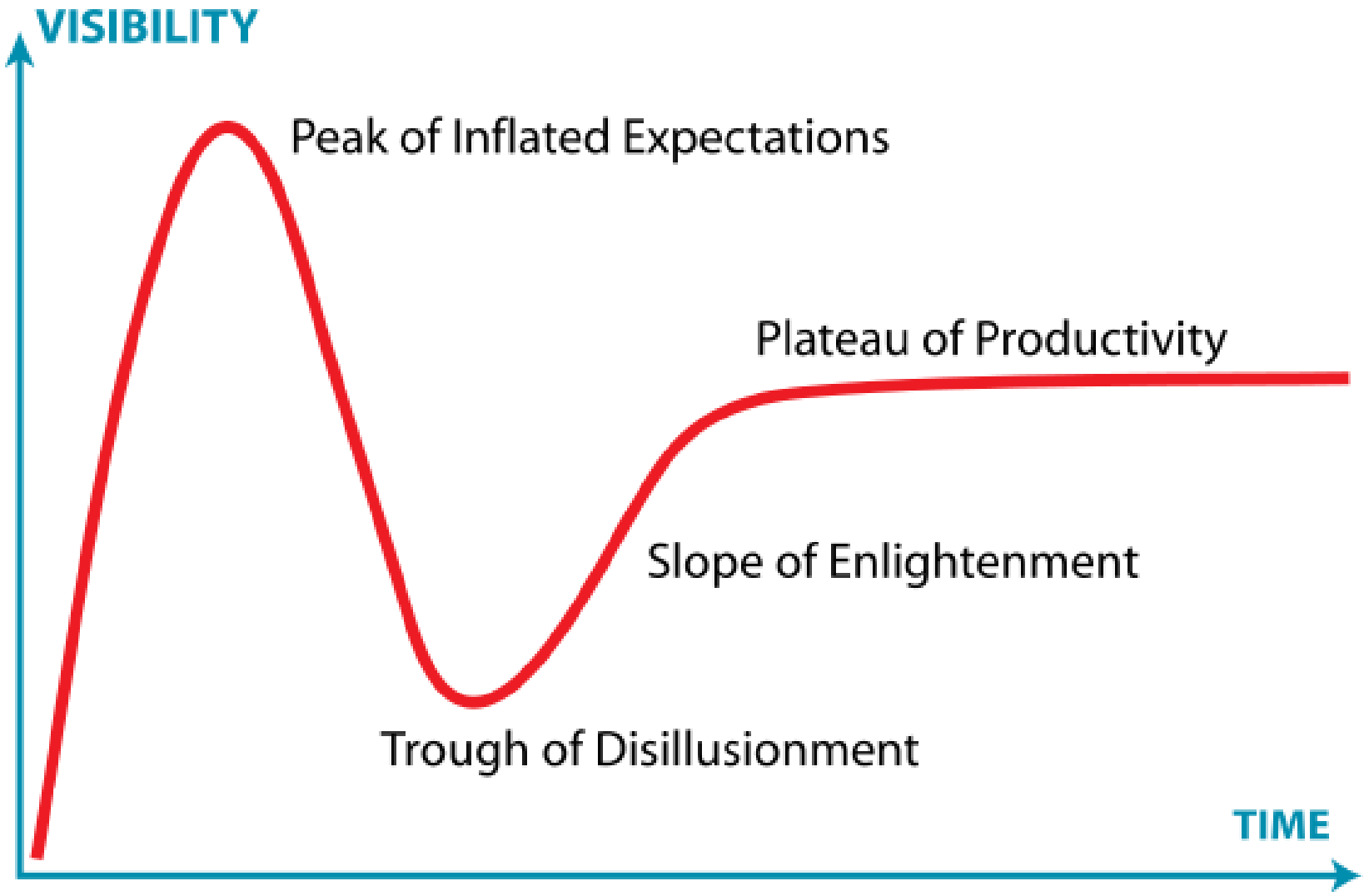
The Wellcome Trust's Hilary Leevers says there has been an "evidence gap" in applying neuroscience in schools.

The Education and Neuroscience project wants to fund research that will bring together scientists and educators.

Academic articles about “educational neuroscience”

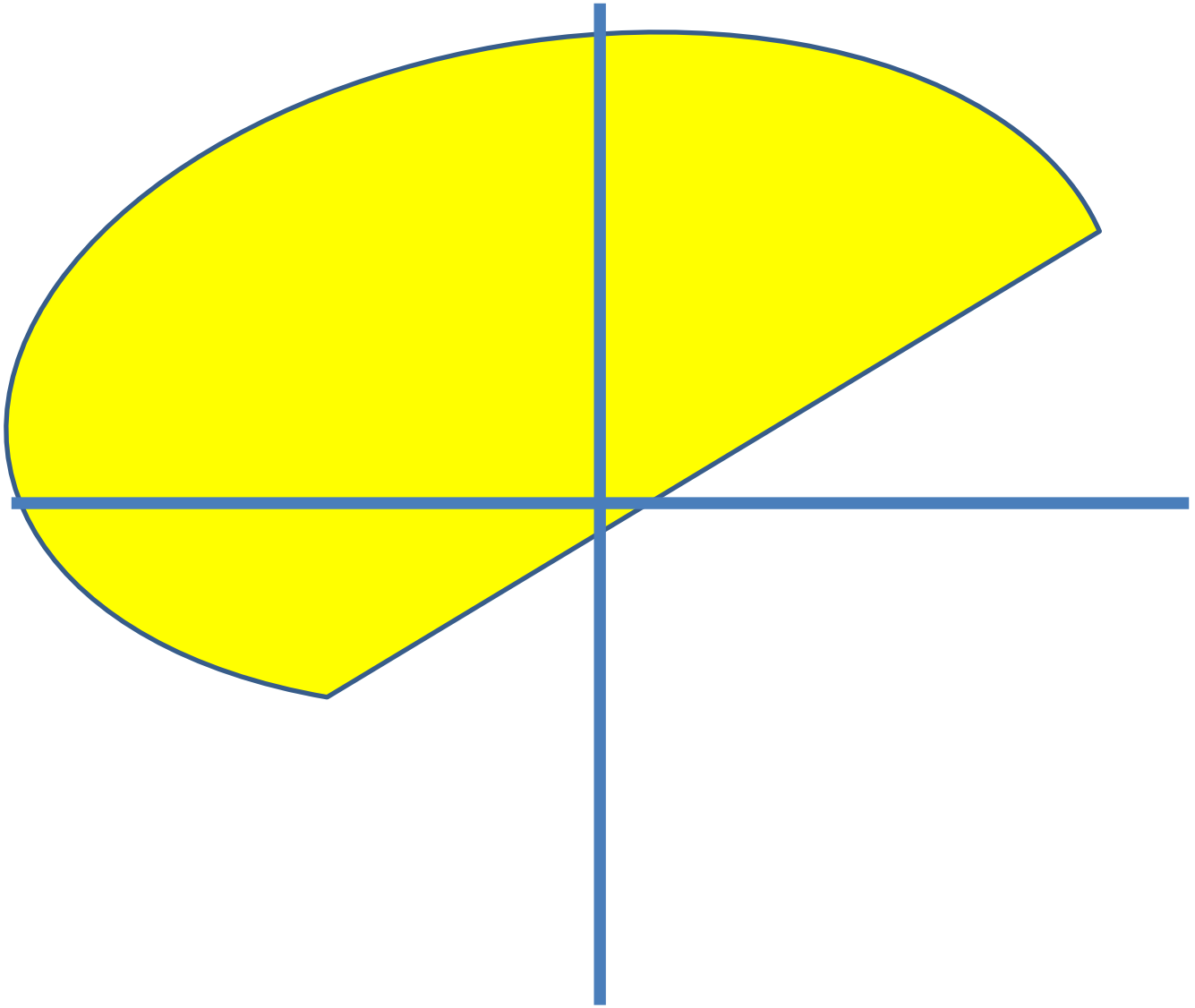


Gartner Hype Cycle (new technology)

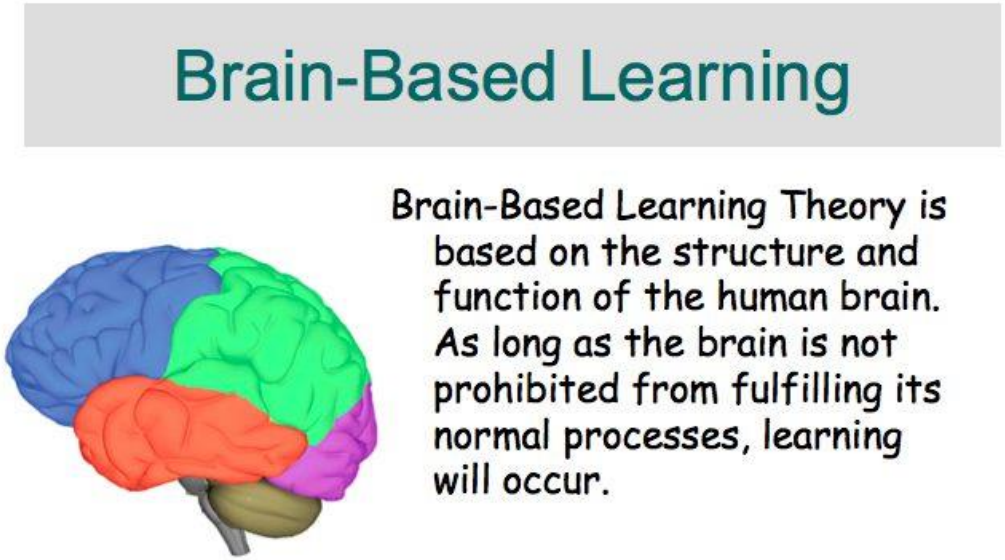


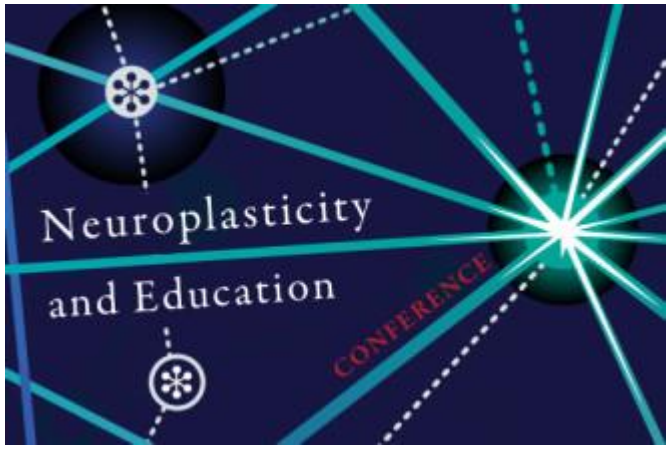
NO-----Could it be useful for education?----YES

YES----Is it neuroscience?---NO



Is it (nontrivially) neuroscience?





At a trivial level, ALL education involves neuroscience, because learning takes place in the brain

- Brain-based learning = tautology

- "Neuroplasticity": the brain's ability to change as a result of experience.
  - If it wasn't true you wouldn't be in the teaching profession

Pretend neuroscience

theguardian

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News › Science › Neuroscience

How Barbara Arrowsmith-Young rebuilt her own brain

She realised that part of her brain was not functioning properly so she devised a series of cognitive exercises to develop it. The results changed her life – and now she has helped thousands of children with learning disabilities

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Brain Training 101

The Science Behind Brain Training | How Brain Training Works | How Do We Know Brain Training Works? | What Can Brain Training Mean to You and Your Family? | Brain Training Rewires Brains & Changes Lives

Brain Training 101: It begins with Neuroplasticity, the Science behind Brain

How can we judge interventions?

Friday, 24 February 2012

Neuroscientific interventions for dyslexia: red flags

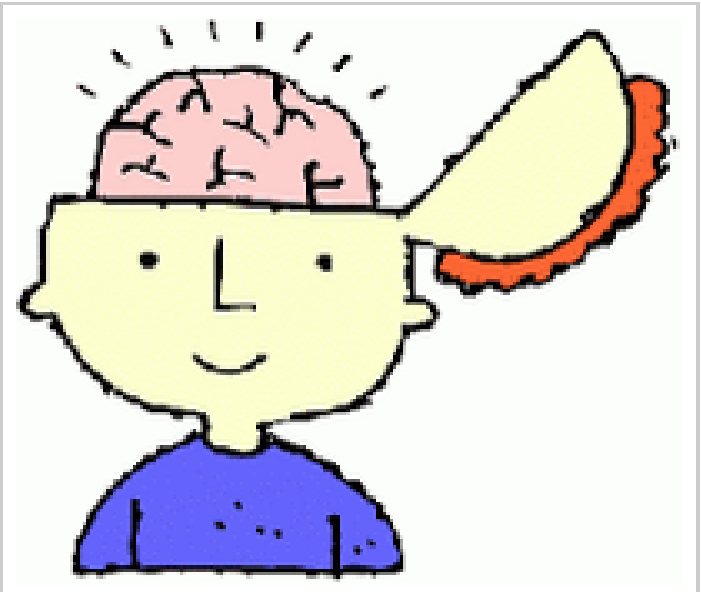
Who is behind intervention?

Credible scientific basis?

Who is it recommended for?

Are costs transparent/reasonable?

Are there any controlled trials?



http://deevybee.blogspot.co.uk/2012/02/neuroscientific-interventions-for.html

Uninteresting reasons why scores may improve - 1

- Maturation

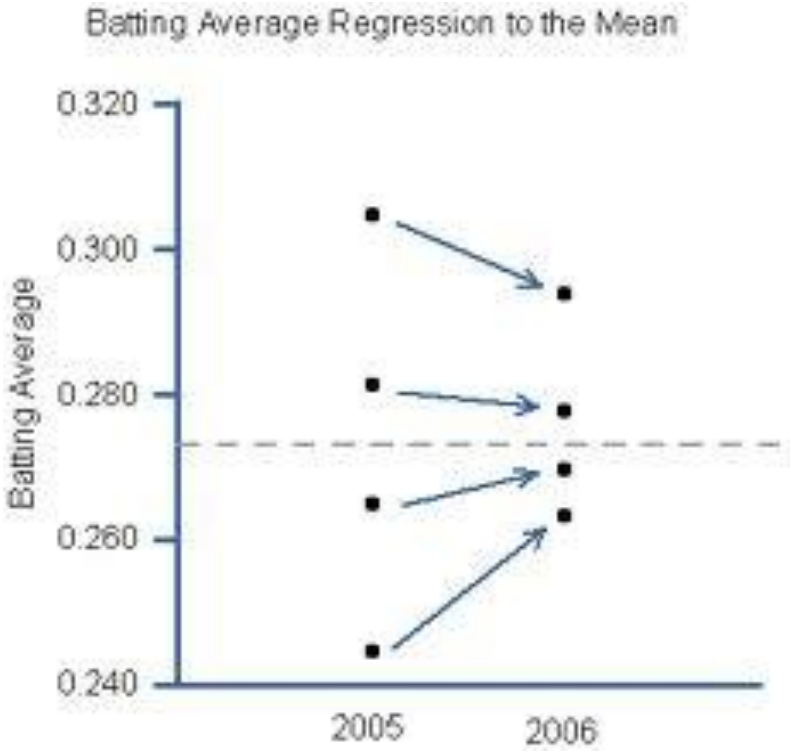
Uninteresting reasons why scores may improve - 2

- Practice effects
  - Performance changes 2nd time around

Uninteresting reasons why scores may improve -3

Regression to the mean

Statistical artefact whereby someone selected for extreme score at time 1 will on average have less extreme score at time 2



http://deevybee.blogspot.co.uk/2010/08/three-ways-to-improve-cognitive-test.html

Uninteresting reasons why scores may improve - 4

- Placebo effect / effect of other intervention
  - Child may be having other help or may respond to increased attention
  - parent, teachers all expect and want
  - gains

Example: Trial of Sunflower therapy

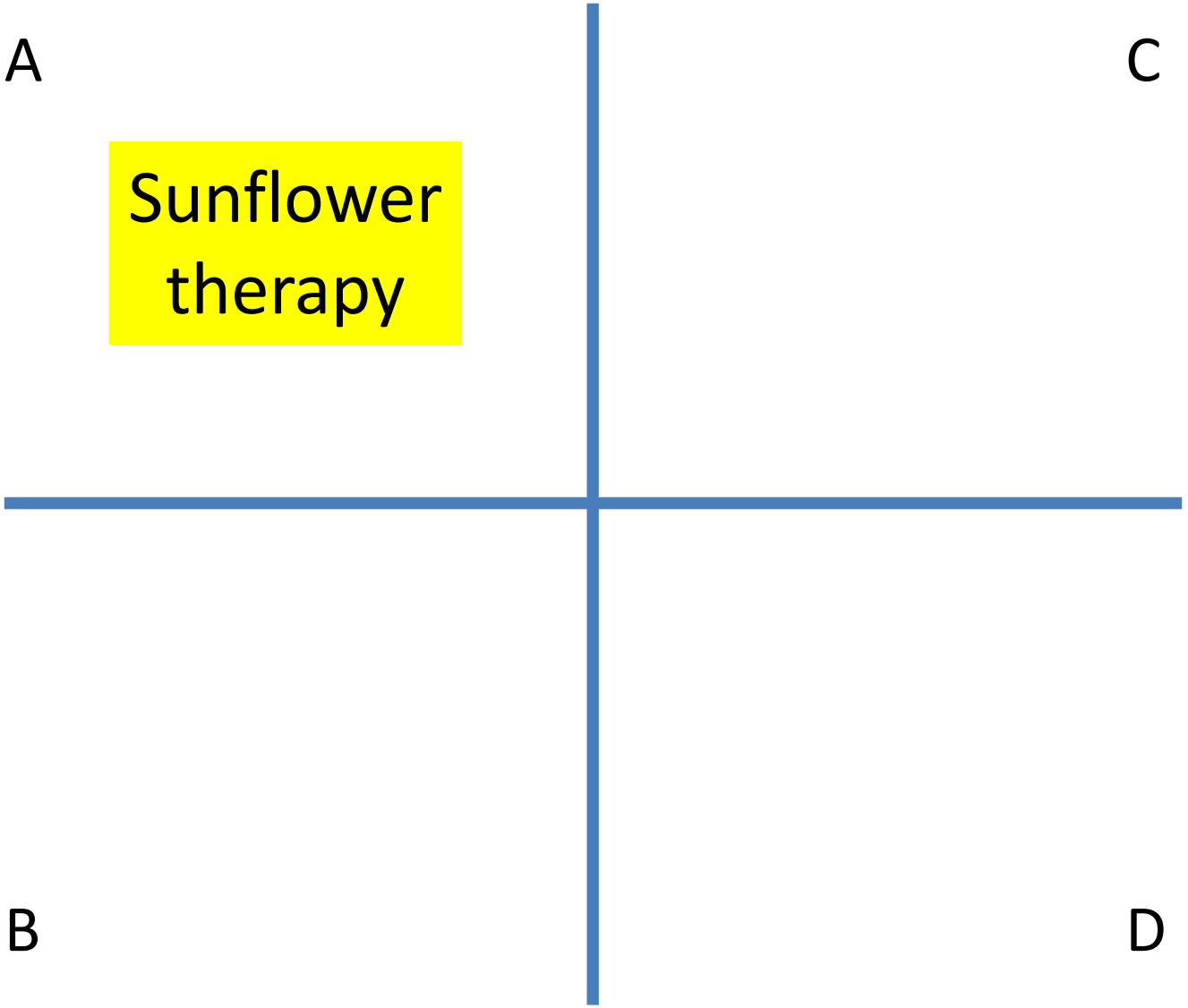
The Sunflower Programme looks at three key areas: Musculoseletal, Neurological and Biochemical

- Includes applied kinesiology, physical manipulation, massage, homeopathy, herbal remedies and neuro-linguistic programming
- Higher academic self-esteem in those undergoing treatment
- 57% of parents thought Sunflower therapy was effective in treating learning difficulties
- RCT found similar gains in test scores for clinical and control children

Bull, L. (2007). Sunflower therapy for children with specific learning difficulties (dyslexia): A randomised, controlled trial. *Complement Ther Clin Pract, 13*, 15-24.

NO-----Could it be useful for education?----YES

YES----Is it neuroscience?---NO



2nd quadrant: Yes, it's neuroscience, But is it useful for education?

- Much developmental neuroscience research using brain-imaging to study correlates of different cognitive processes, or predictors of outcomes

- Justified by saying could help identify children at risk of problems/those that will benefit from treatment

Dyslexia 'seen in brain scans' of pre-school children

By Michelle Roberts
Health editor, BBC News online

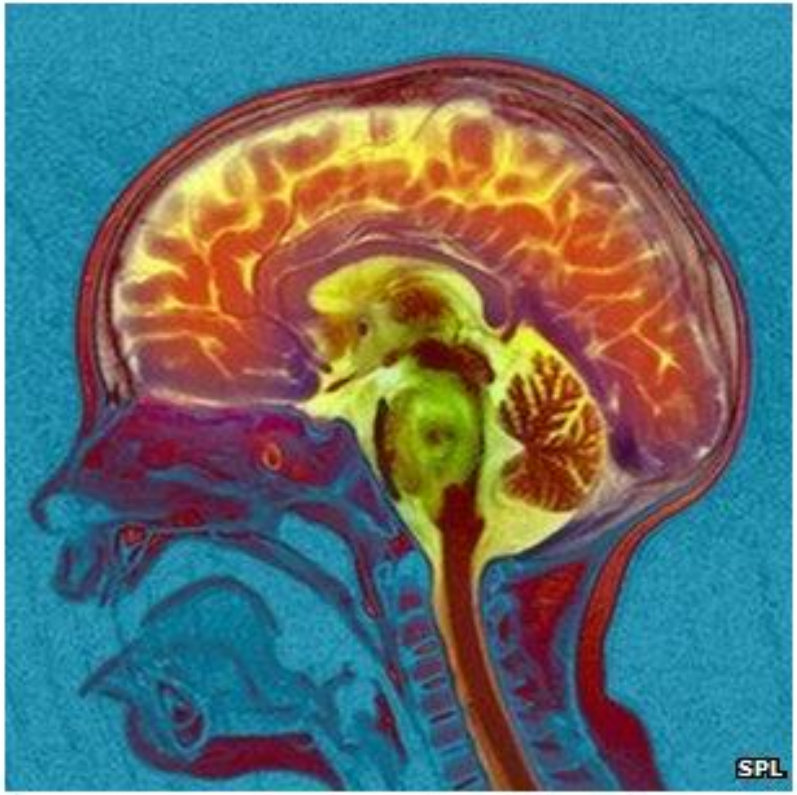
Brain scans may allow detection of dyslexia in pre-school children even before they start to read, say researchers.

A US team found tell-tale signs on scans that have already been seen in adults with the condition.

And these brain differences could be a cause rather than a consequence of dyslexia - something unknown until now - the Journal of Neuroscience reports.

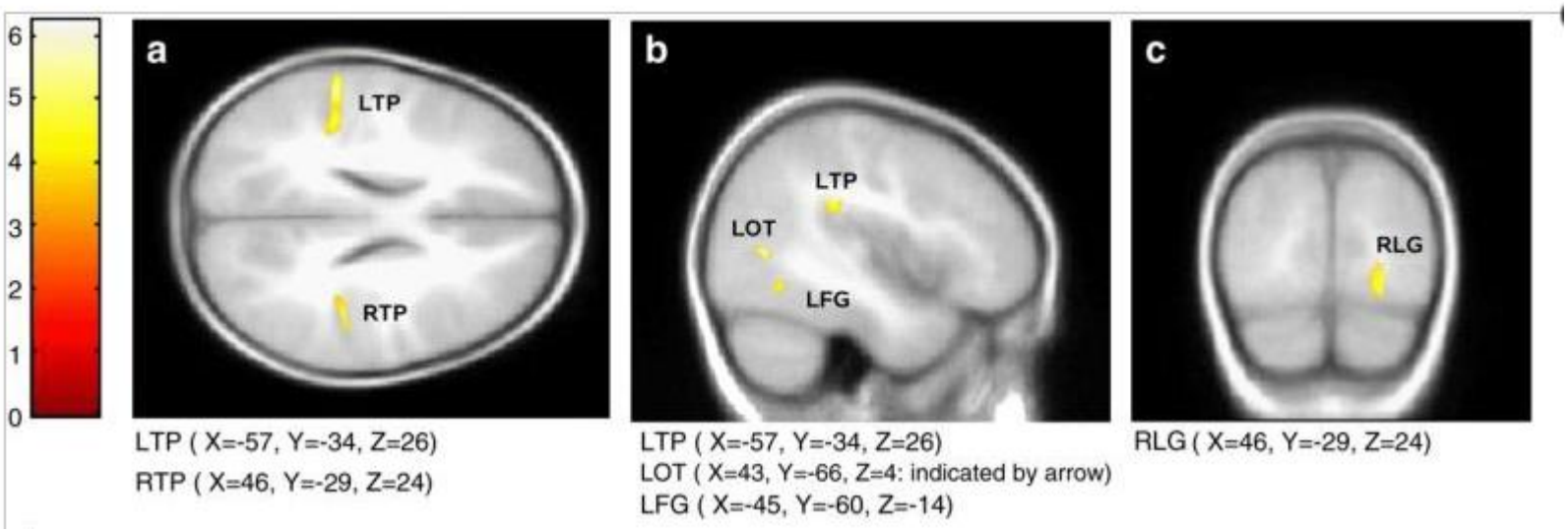
Scans could allow early diagnosis and intervention, experts hope.

The part of the brain affected is called the arcuate fasciculus.



Scans may reveal early markers of dyslexia, experts hope

Raschle NM, Chang M, and Gaab N. 2011. Structural brain alterations associated with dyslexia predate reading onset. *Neuroimage 57:742-749.*



"Further studies using larger sample sizes and longitudinal analyses are needed in order to determine whether the identified structural alterations may be utilized as structural markers for the **early identification of children at risk,** which may prevent the negative clinical, social and psychological outcome of developmental dyslexia."

Neuroscience in screening?

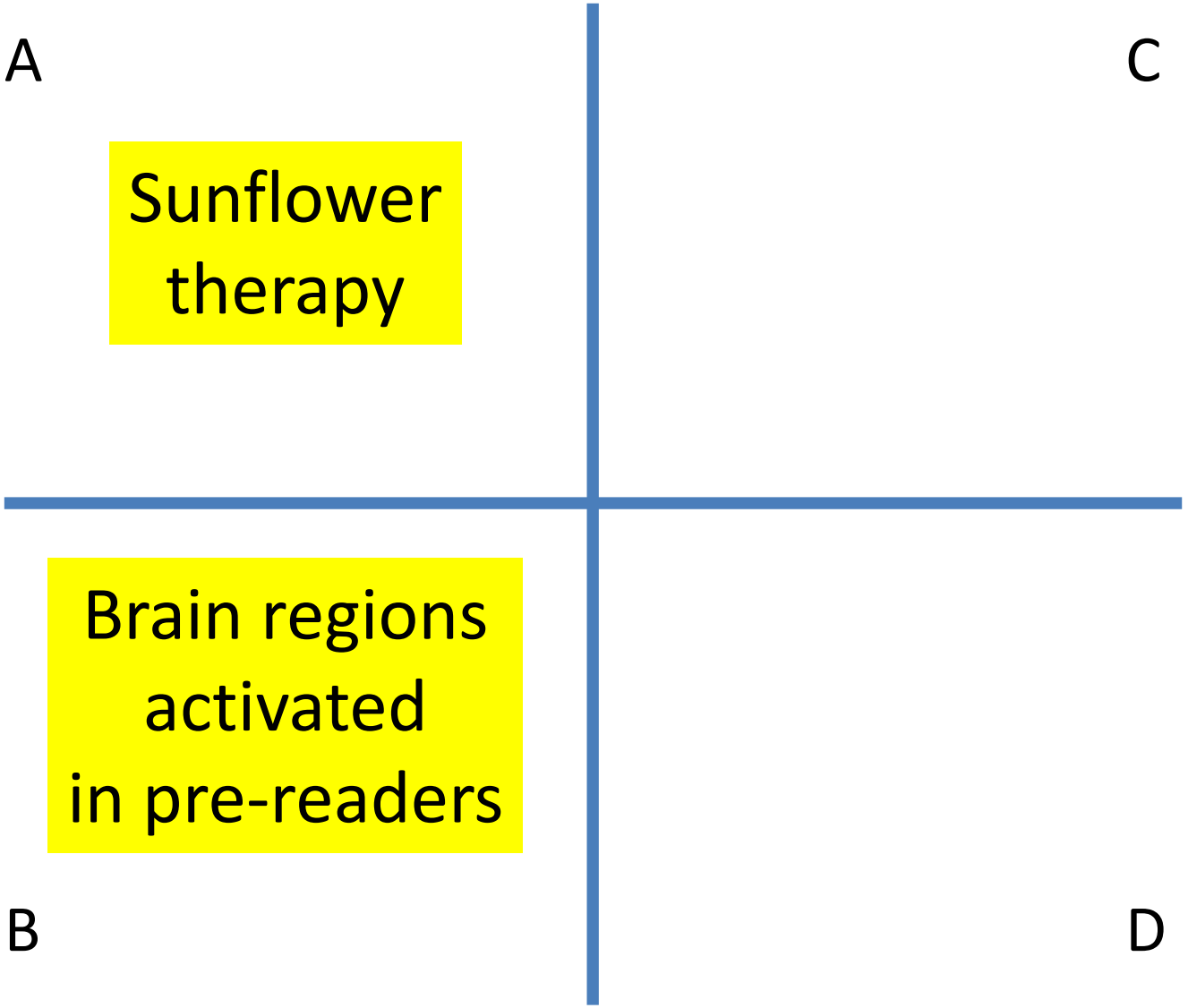
- Unrealistic!

- For effective screening need very high levels of sensitivity and specificity, using measures that are quick and inexpensive

- Can identify children at risk of reading impairment quite effectively using simple tests of letter knowledge/phonological awareness

NO-----Could it be useful for education?----YES

YES----Is it neuroscience?---NO

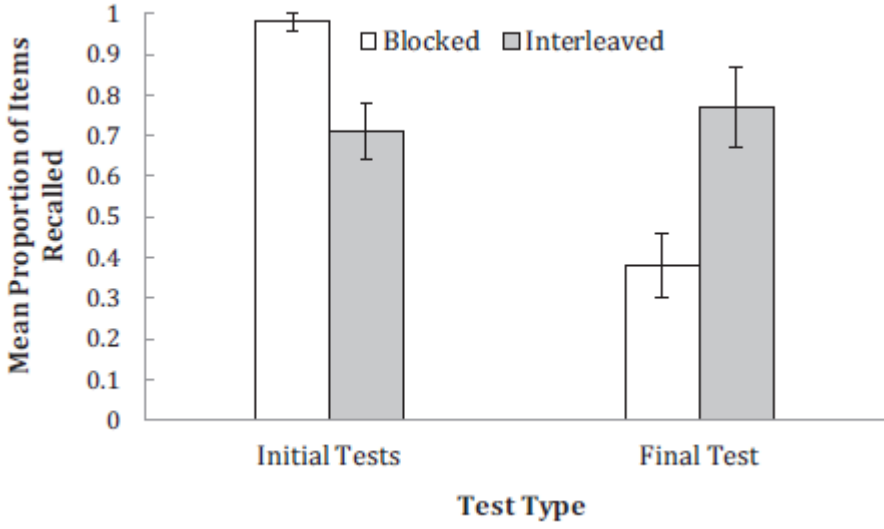


Quadrant C

Educationally useful: but is it neuroscience?

Spaced learning

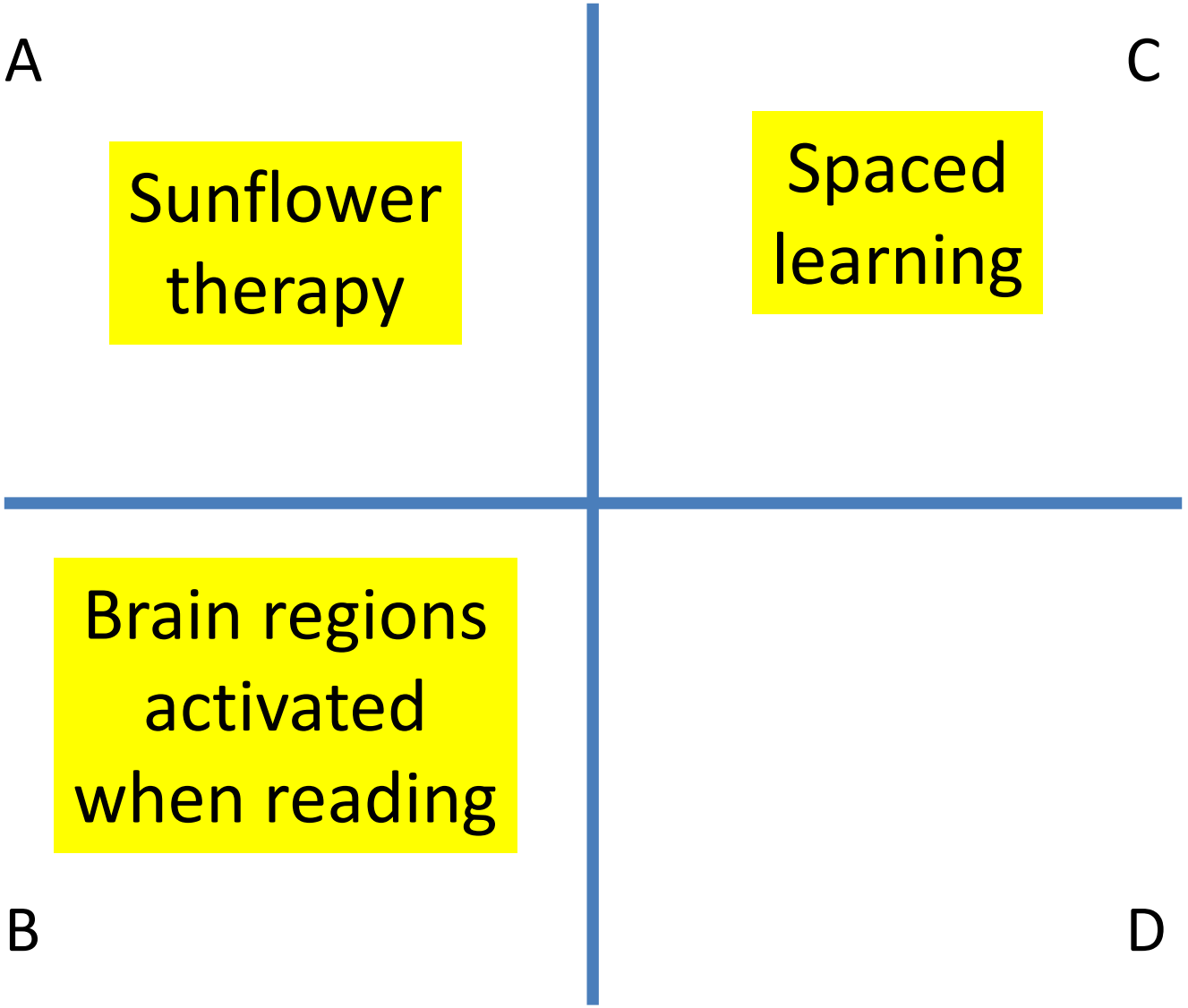
- Described by Ebbinghaus in 1885
- Huge volume of research on it
- Interleaved learning: slower initially but better retention if learning tasks interleaved
- "Concept of desirable difficulties": Procedures that produce fast learning can produce fast forgetting



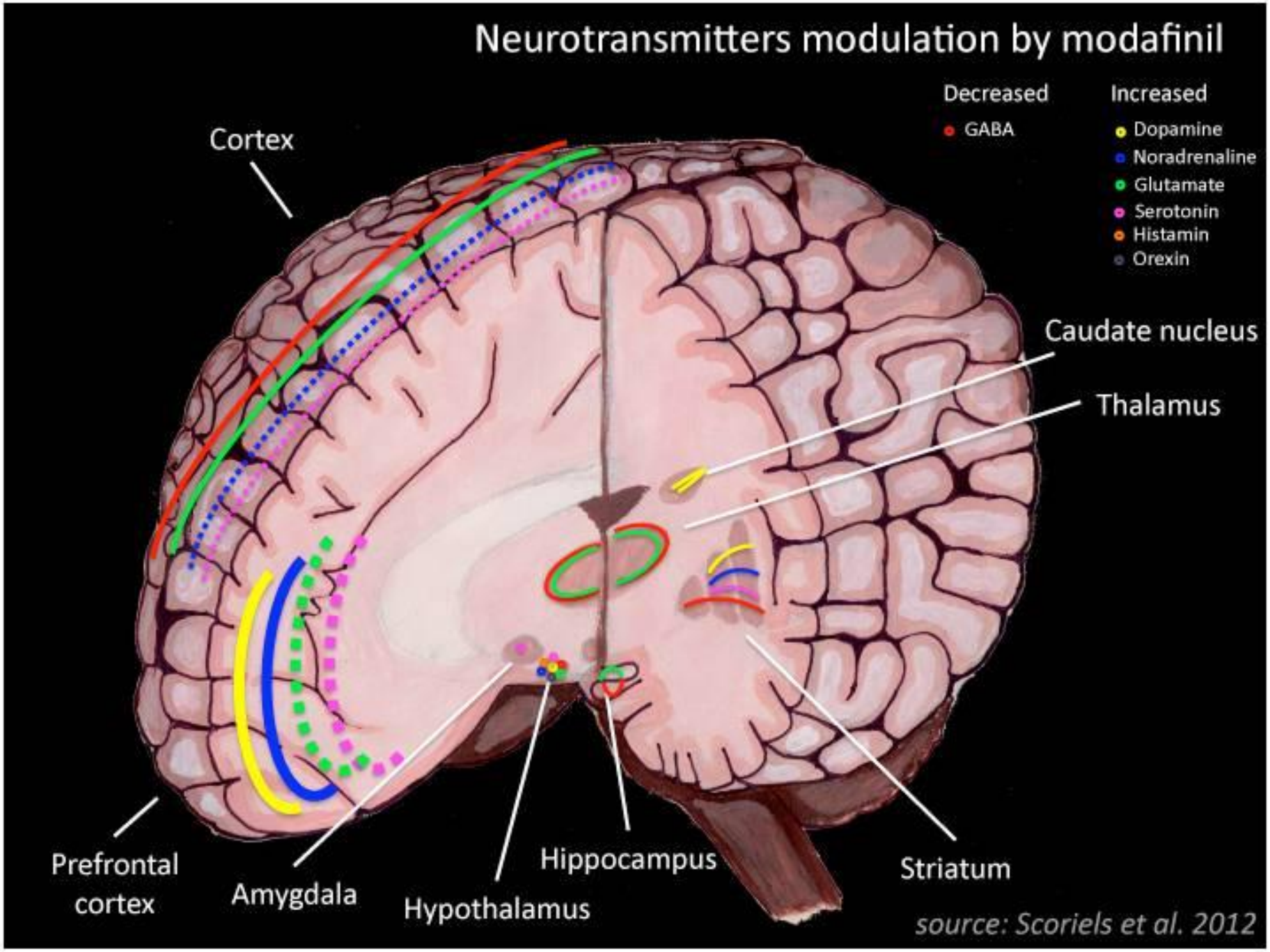
Roediger HL, and Pyc MA. 2012. Inexpensive techniques to improve education: Applying cognitive psychology to enhance educational practice. *Journal of Applied Research in Memory and Cognition 1:242-248.*

NO-----Could it be useful for education?----YES

YES----Is it neuroscience?---NO



What is in quadrant D?


Neurotransmitters modulation by modafinil
Decreased
GABA
Increased
Dopamine
Noradrenaline
Glutamate
Serotonin
Histamin
Orexin
Cortex
Caudate nucleus
Thalamus
Prefrontal cortex
Amygdala
Hypothalamus
Hippocampus
Striatum
source: Scoriels et al. 2012

Can Electric Current Make People Better at Math?

Scientists find mild jolts to the brain may improve performance with numbers

Updated Feb. 18, 2014 3:32 p.m. ET

Oxford, England

In a lab in Oxford University's experimental psychology department, researcher Roi Cohen Kadosh is testing an intriguing treatment: He is sending low-dose electric current through the brains of adults and children as young as 8 to make them better at math.

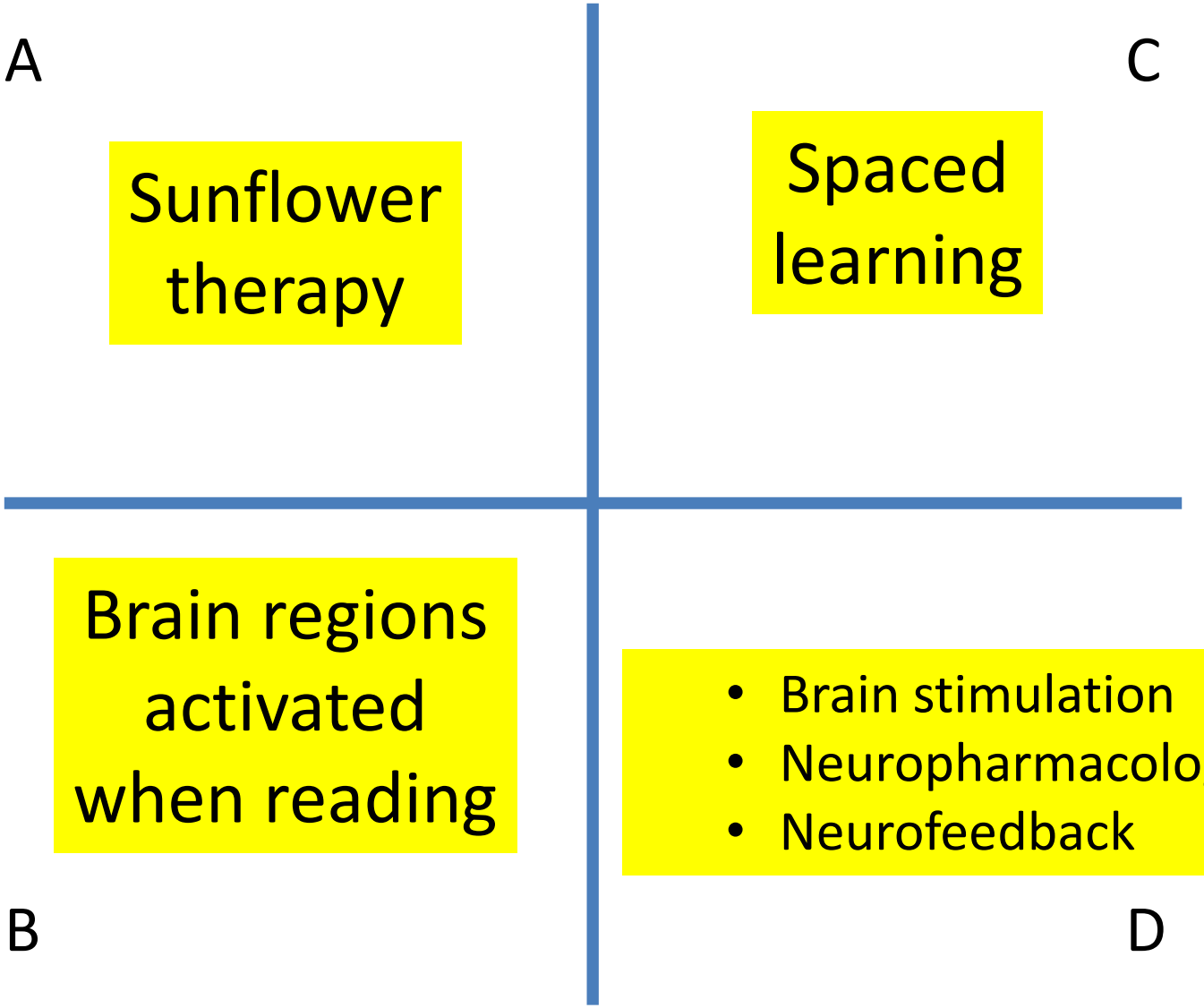
A relatively new brain-stimulation technique called transcranial electrical stimulation may help people learn and improve their understanding of math concepts.

Neurofeedback for the non-pharmacological treatment of ADHD

neuroConn's neurofeedback devices are used worldwide to treat patients effectively with ADHD and other indications.

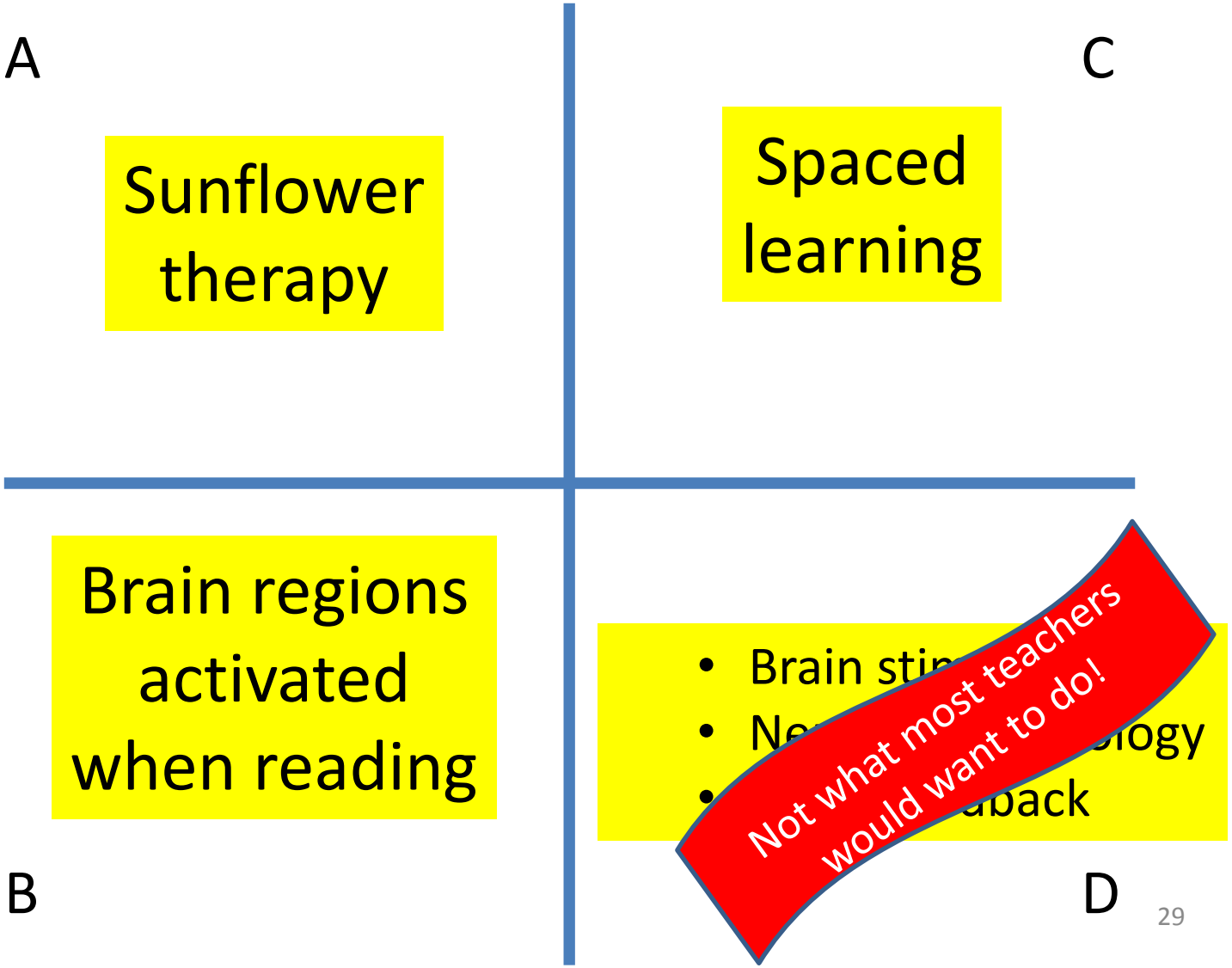
NO-----Could it be useful for education?----YES

YES----Is it neuroscience?---NO

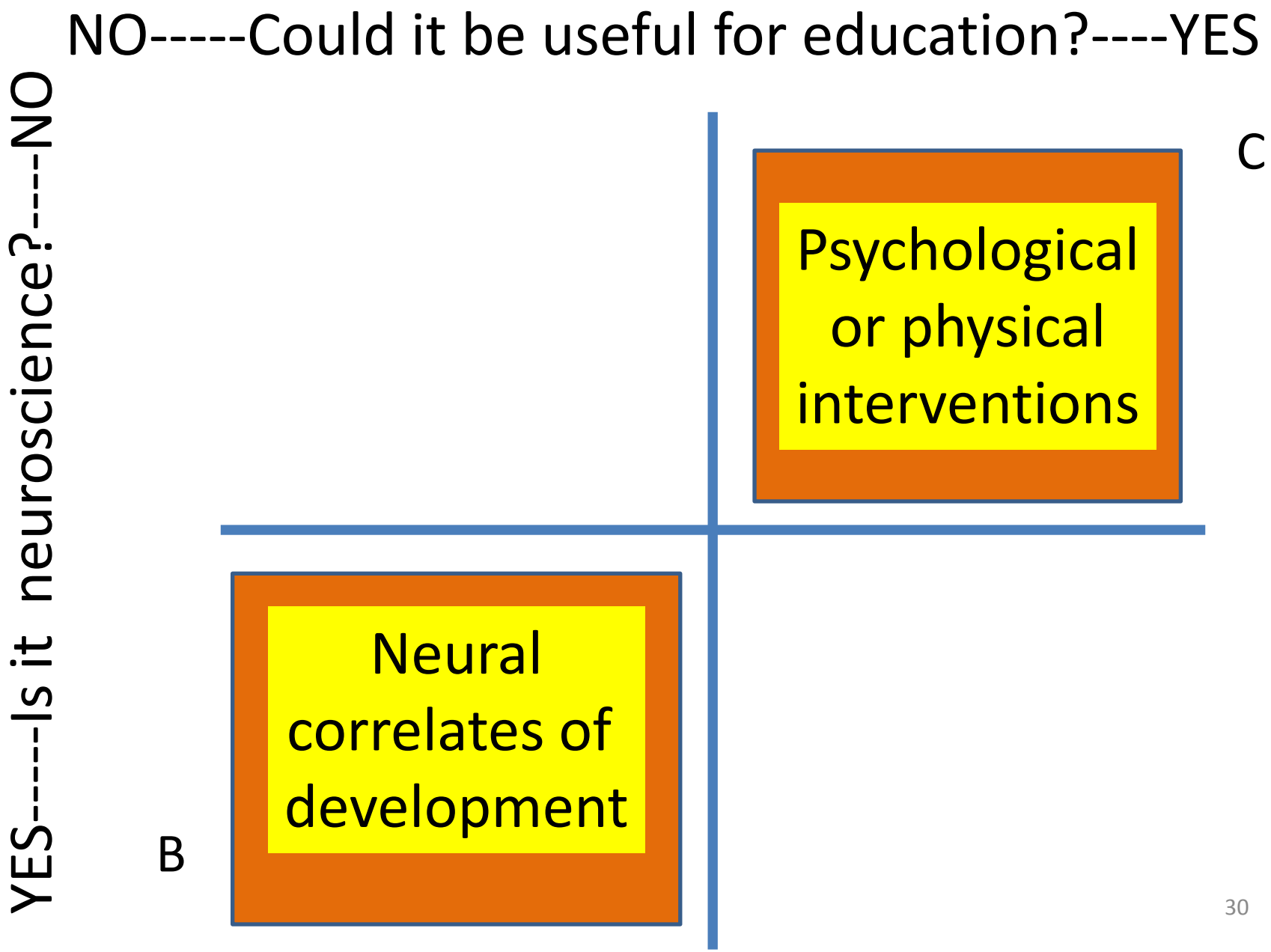


NO-----Could it be useful for education?----YES

YES----Is it neuroscience?---NO



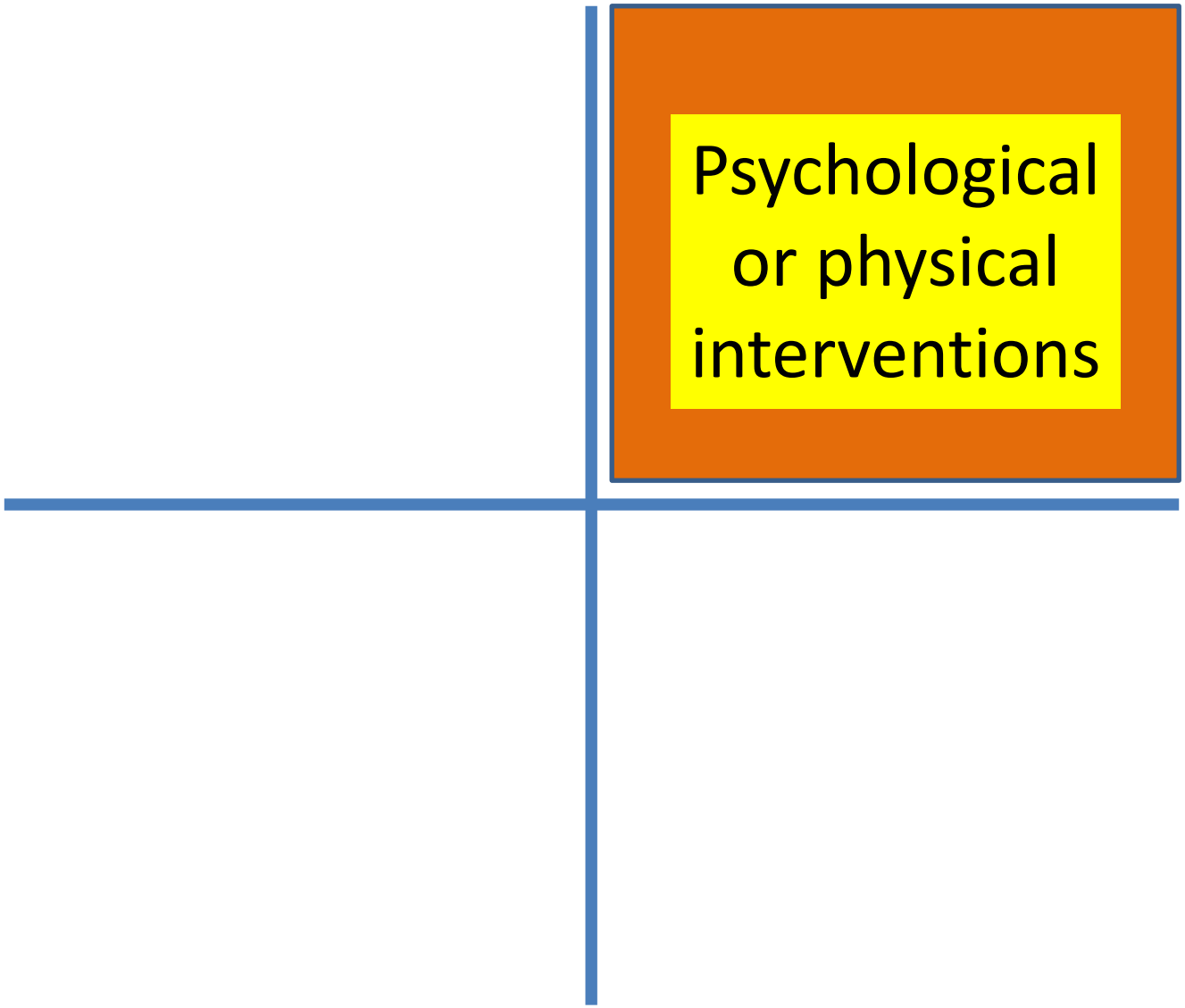
Most of what is termed “educational neuroscience” is one of these



Where teachers should be focusing .....

NO-----Could it be useful for education?----YES

YES----Is it neuroscience?---NO



John T. Bruer
President: James S. McDonnell Foundation

- **Supposed implications of developmental neuroscience do not cohere with what cognitive and educational psychology has revealed about learning.**
- **Currently, cognitive psychology is the best candidate for a basic science of learning.**
- **In future, cognitive neuroscience is the field most likely to develop educationally relevant brain science**

Bruer JT. 1997. Education and the brain: A bridge too far. *Educational researcher 26:4-16.* *https://www.jsmf.org/about/j/**education**_and_**brain**.pdf*

Psychological Science in the Public Interest (2013) 14:4-58.

Improving Students' Learning With Effective Learning Techniques

Promising Directions From Cognitive and Educational Psychology

John Dunlosky[1],
Katherine A. Rawson[1],
Elizabeth J. Marsh[2],
Mitchell J. Nathan[3] and
Daniel T. Willingham[4]

My blogpost on this topic:

- http://deevybee.blogspot.co.uk/2014/01/what-is-educational-neuroscience.html