

The Science of Intelligence

**Richard Haier
Insight Cruises
December 2014**

Please Note

I enjoyed our time on board and I'm happy to provide these slides but, they are provided for your personal viewing only. They are all copyrighted and cannot be used for any other purpose without my written permission.

Thx----Rich

Also, this is a pdf version of my presentations. The video clips do not function. I do not have permission to post most of them but if you have a special need to see them, please email me:

rich.haier@gmail.com

You can also see more on my website:

www.richardhaier.com



**“There’s so much
about intelligence
that I don’t
understand.”**

...Homer Simpson

Session 2 Where does intelligence come from?

“The study of intelligence and the human brain (what Rich Haier does) is much, much, much more difficult than the study of particle physics.”

...Don Lincoln, co-discover of the Higgs Boson

On board the QM2 December 2, 2014

N.B. This quote is taken completely out of context

Reaction Time

Inspection Time





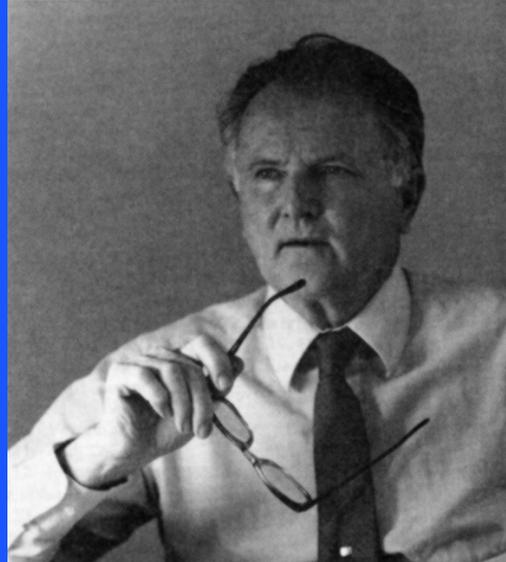
MOVIE Inspection time:



Early Childhood Experiences & Intelligence

Are there any effects at all on intelligence? This has been surprisingly controversial

Arthur Jensen



“We have tried compensatory education and it has failed.”

Effects of Early Education

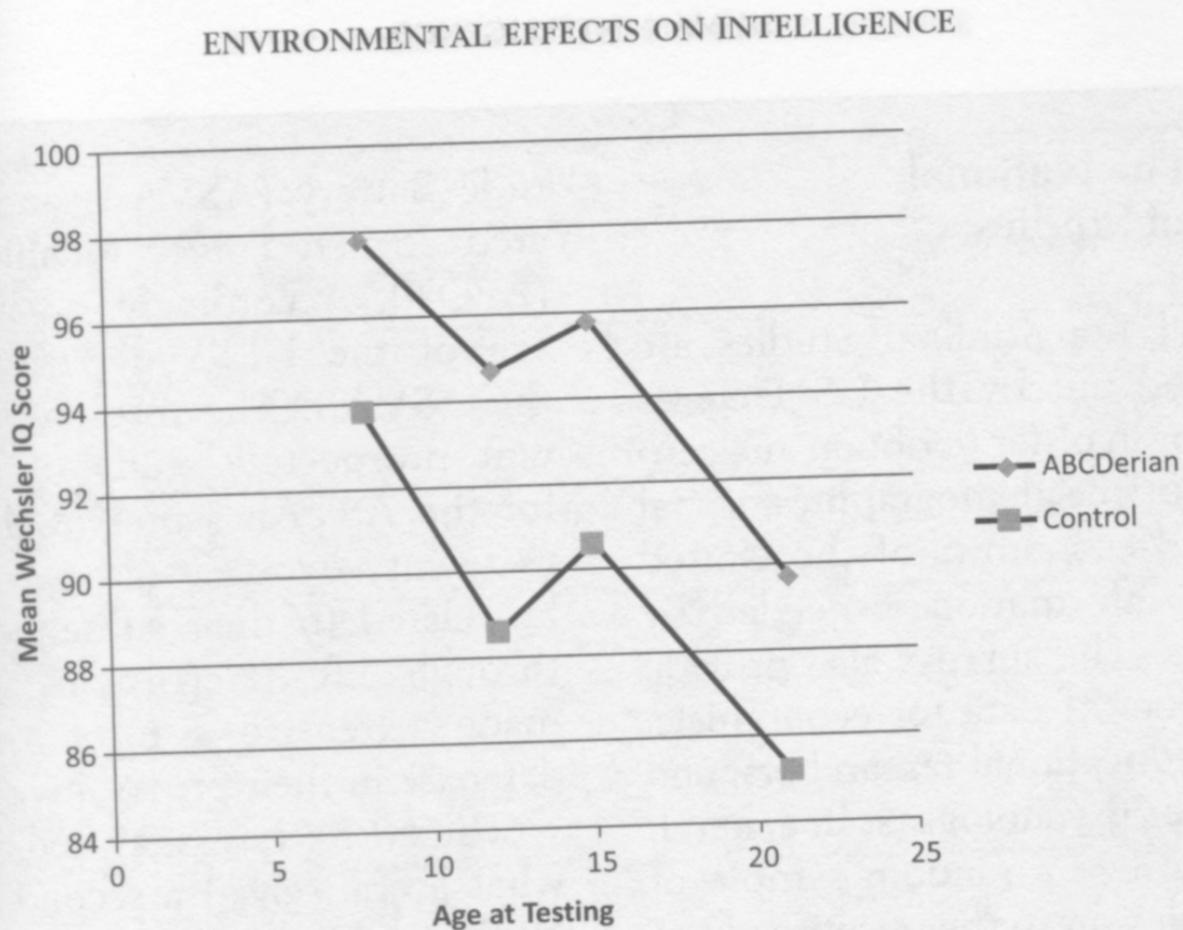


Figure 9.6. Mean IQ scores obtained by the participants in the ABCDerian project and in a randomly chosen control group. The intervention ended when the children entered school, at approximately age six. Data from Campbell et al., 2001, Table 1.



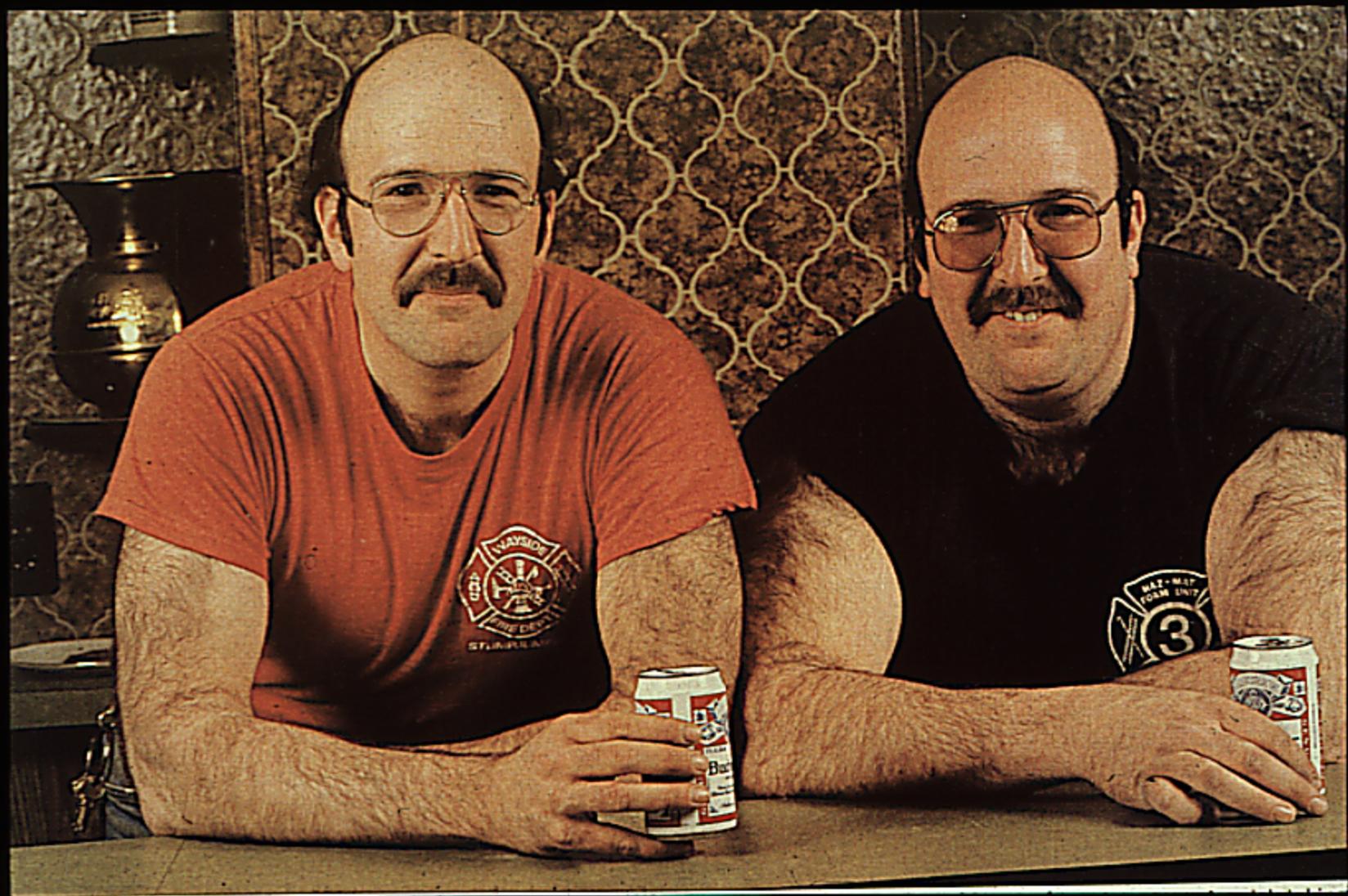
Separated at birth, the Mallifert twins meet accidentally.

Sir Cyril Burt

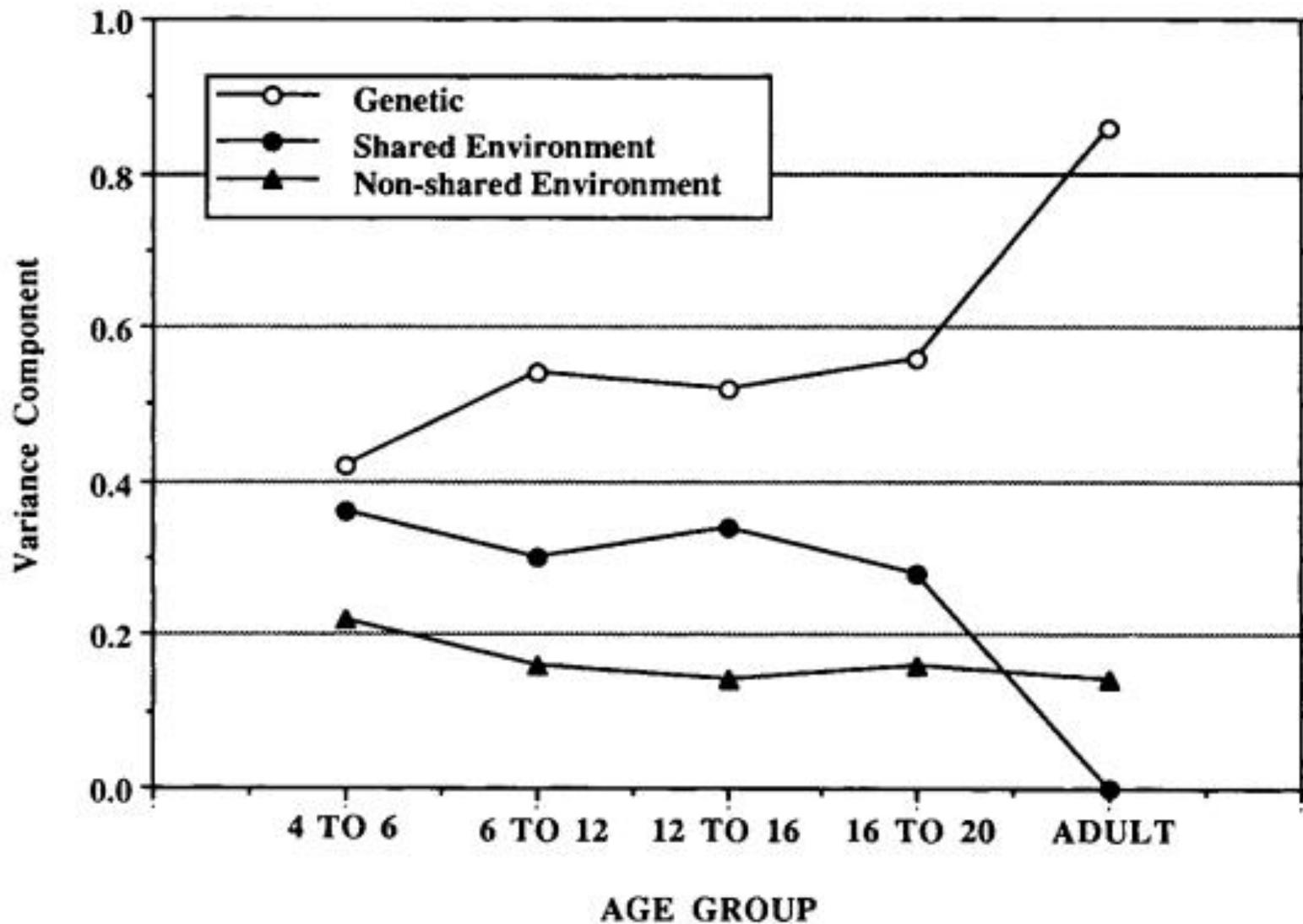


$r = .771$

$r = .771$

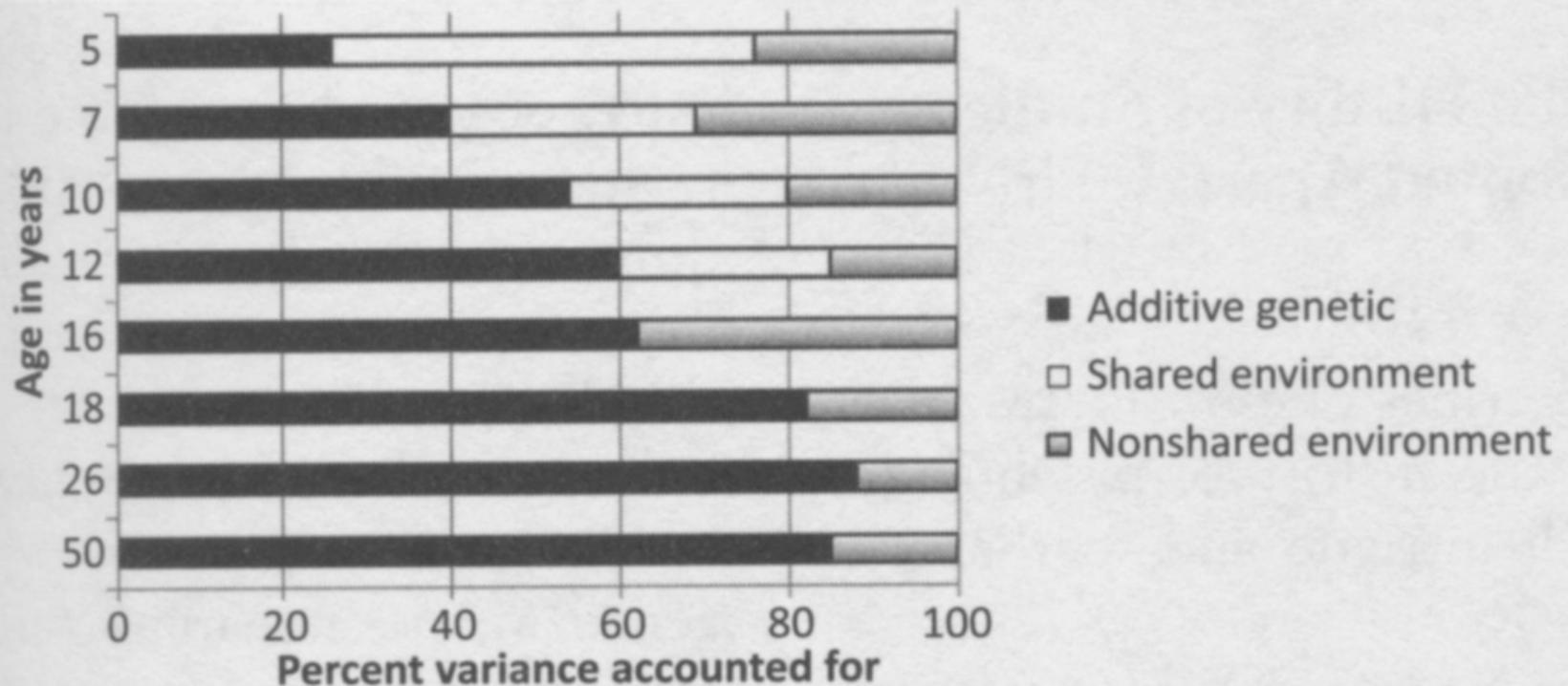


Age Effects on Heritability of intelligence

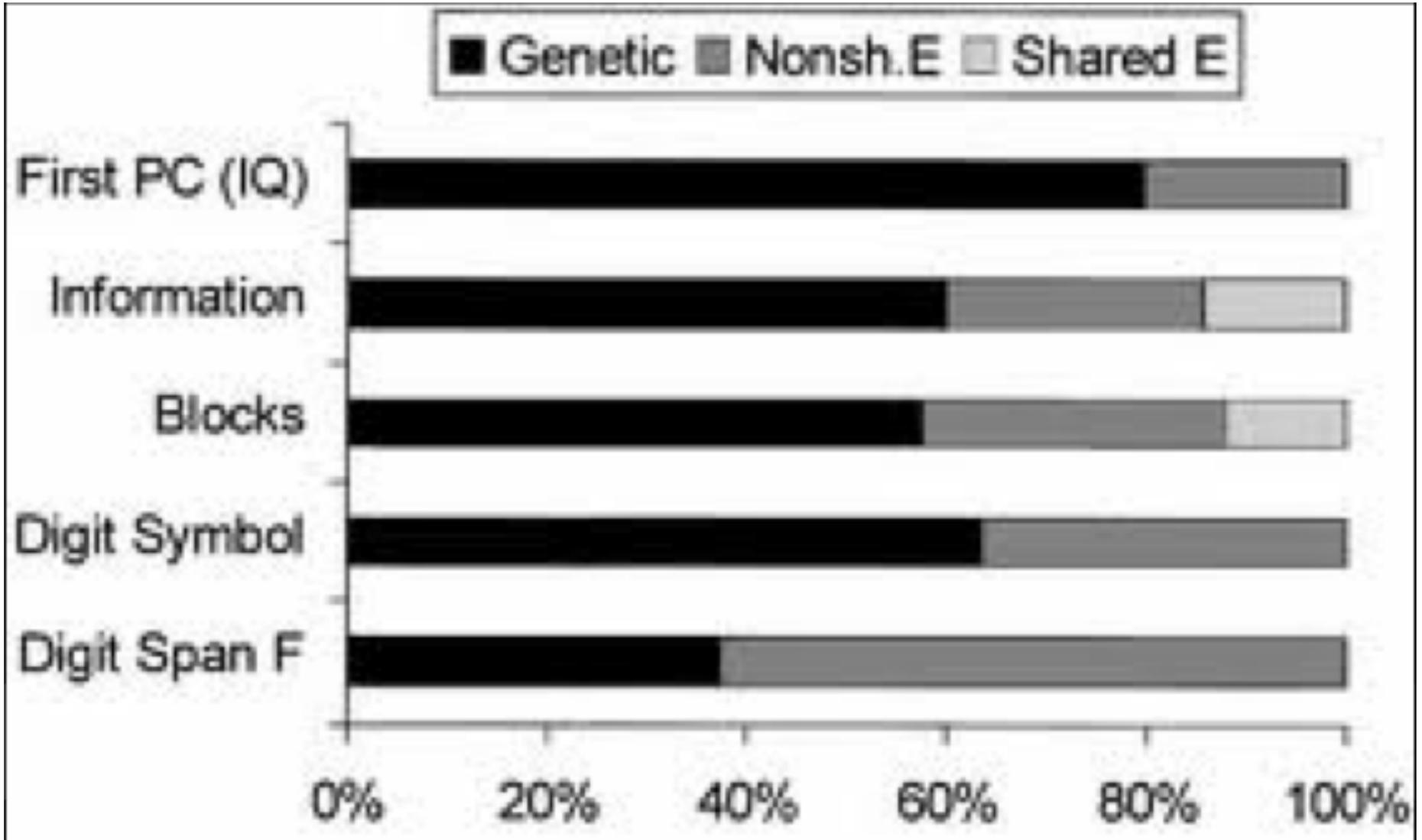


Genes, shared and non-shared environment by age

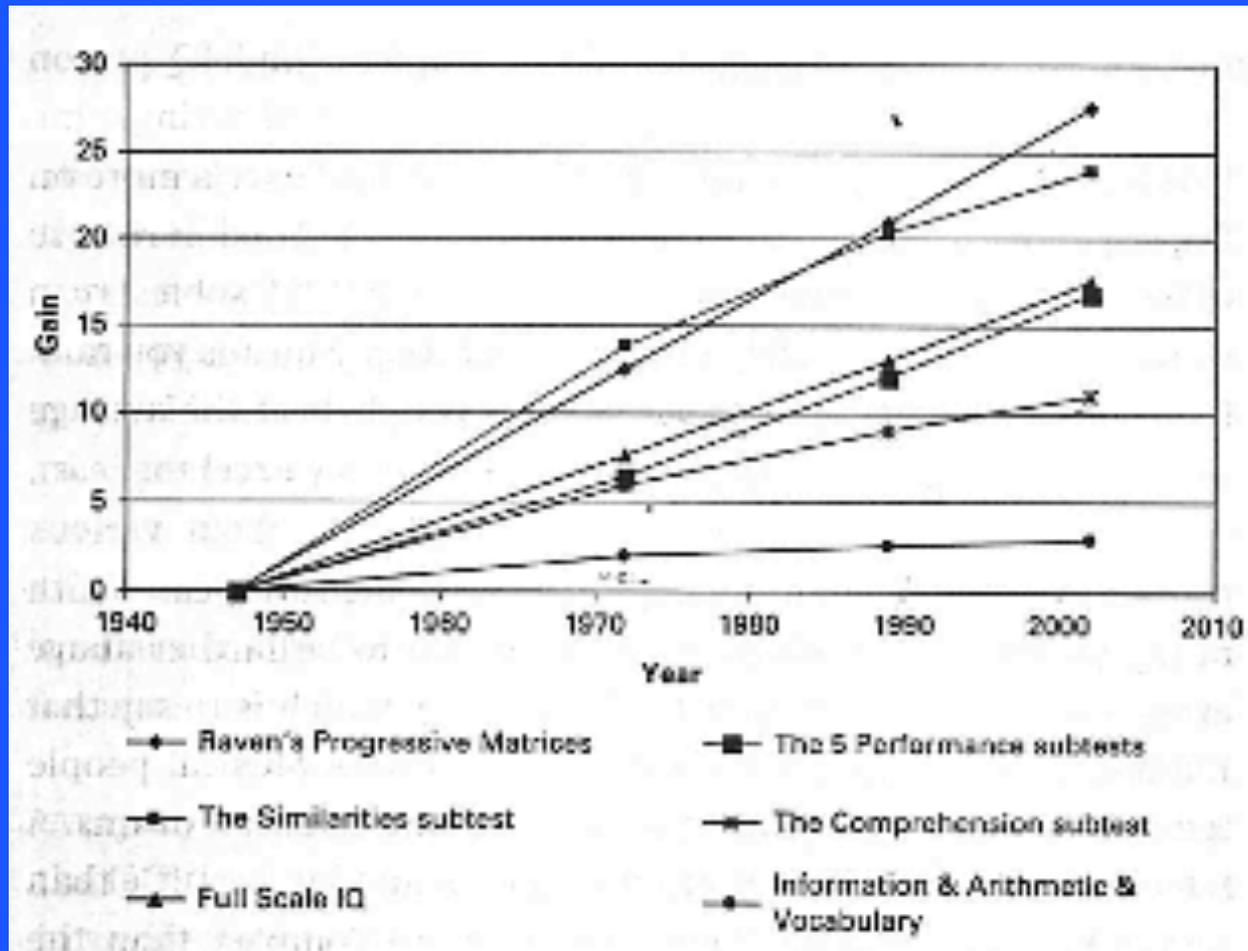
THE GENETIC BASIS OF INTELLIGENCE



Genes, shared and non-shared environment for test scores



The Flynn Effect



ENVIRONMENTAL EFFECTS ON INTELLIGENCE

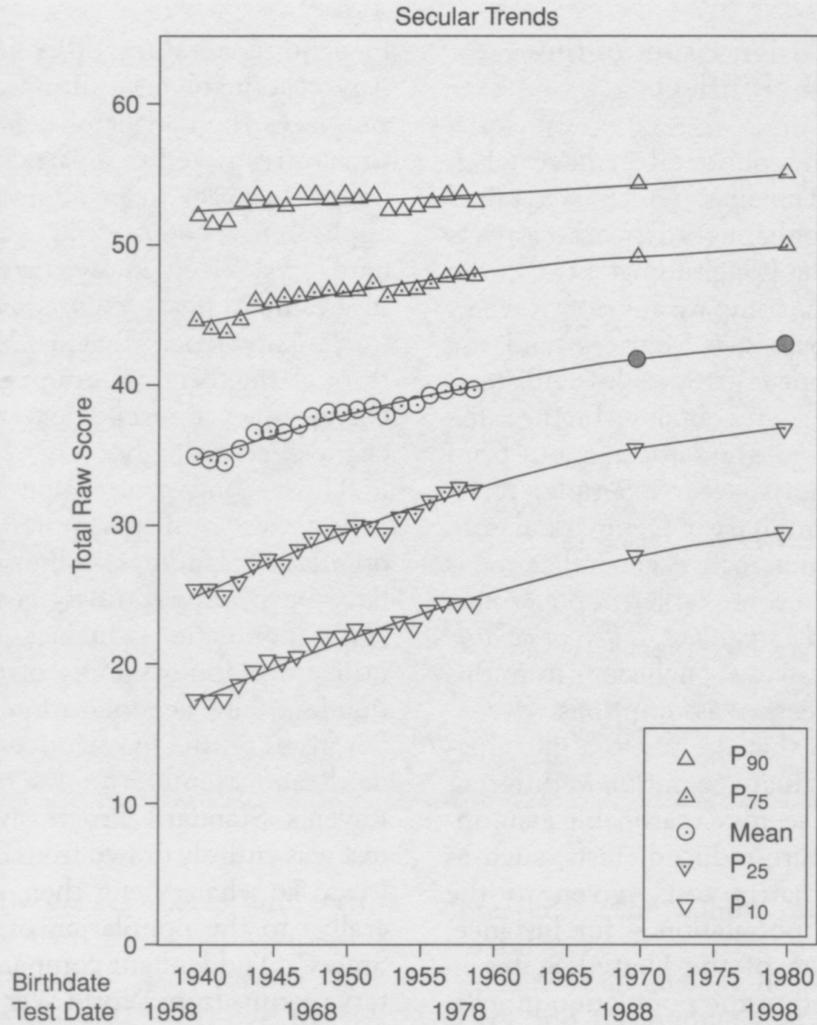
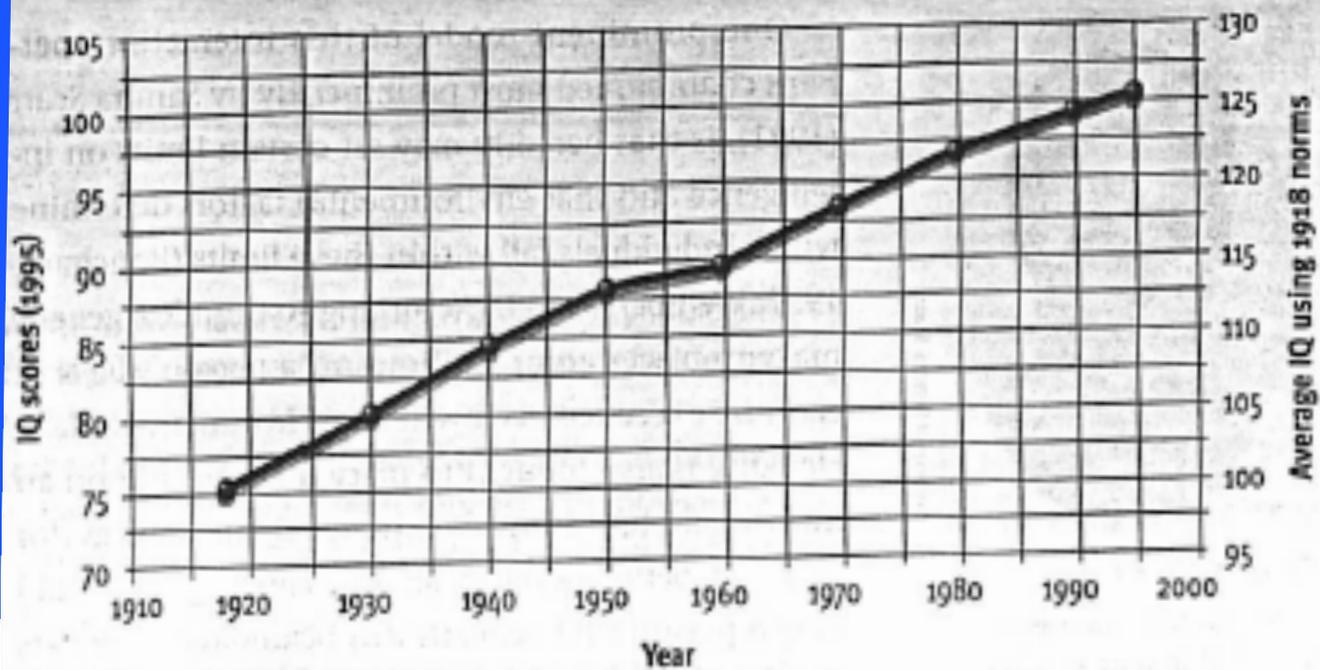


Figure 9.4. Progressive matrix test scores for Danish eighteen-year-old men registering for military enlistment, 1958–98. From Teasdale & Owen, 2000, with permission from Elsevier.



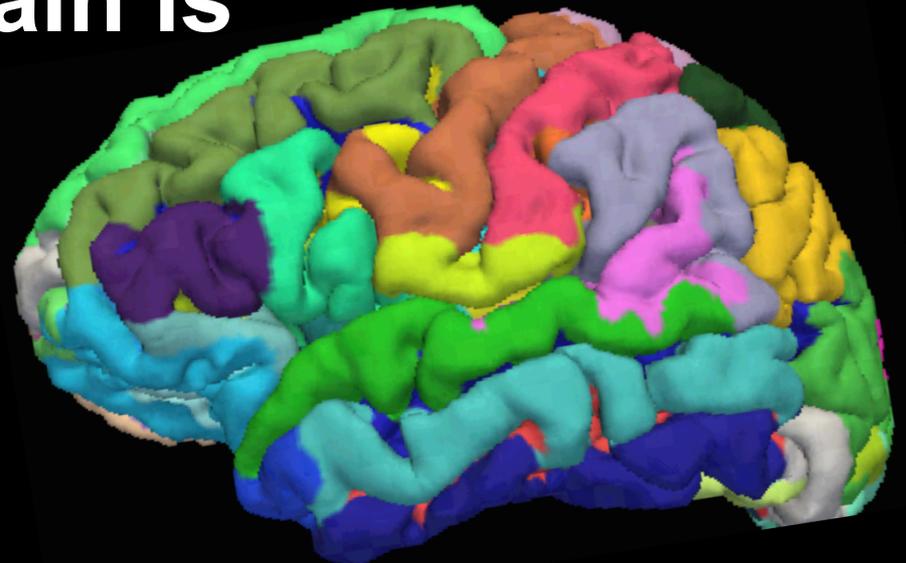
EPIGENETICS

the interaction of genes and
environment

100% biological processes

If something is genetic or epigenetic, it must work through biology, so there must be a biological basis for intelligence and the brain is the place to look.

So, where in the brain is intelligence?



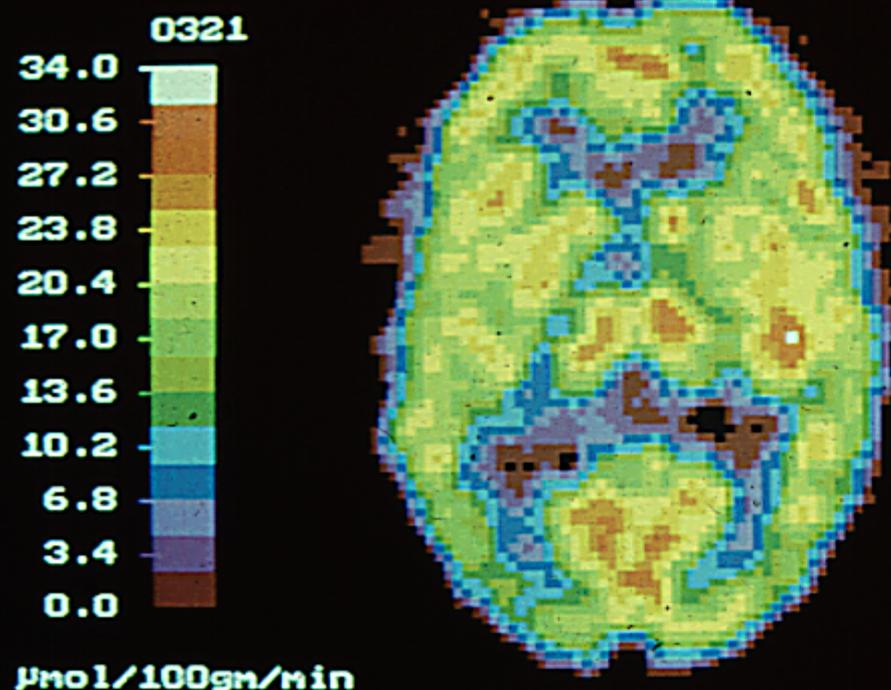
Let's have
a look around.



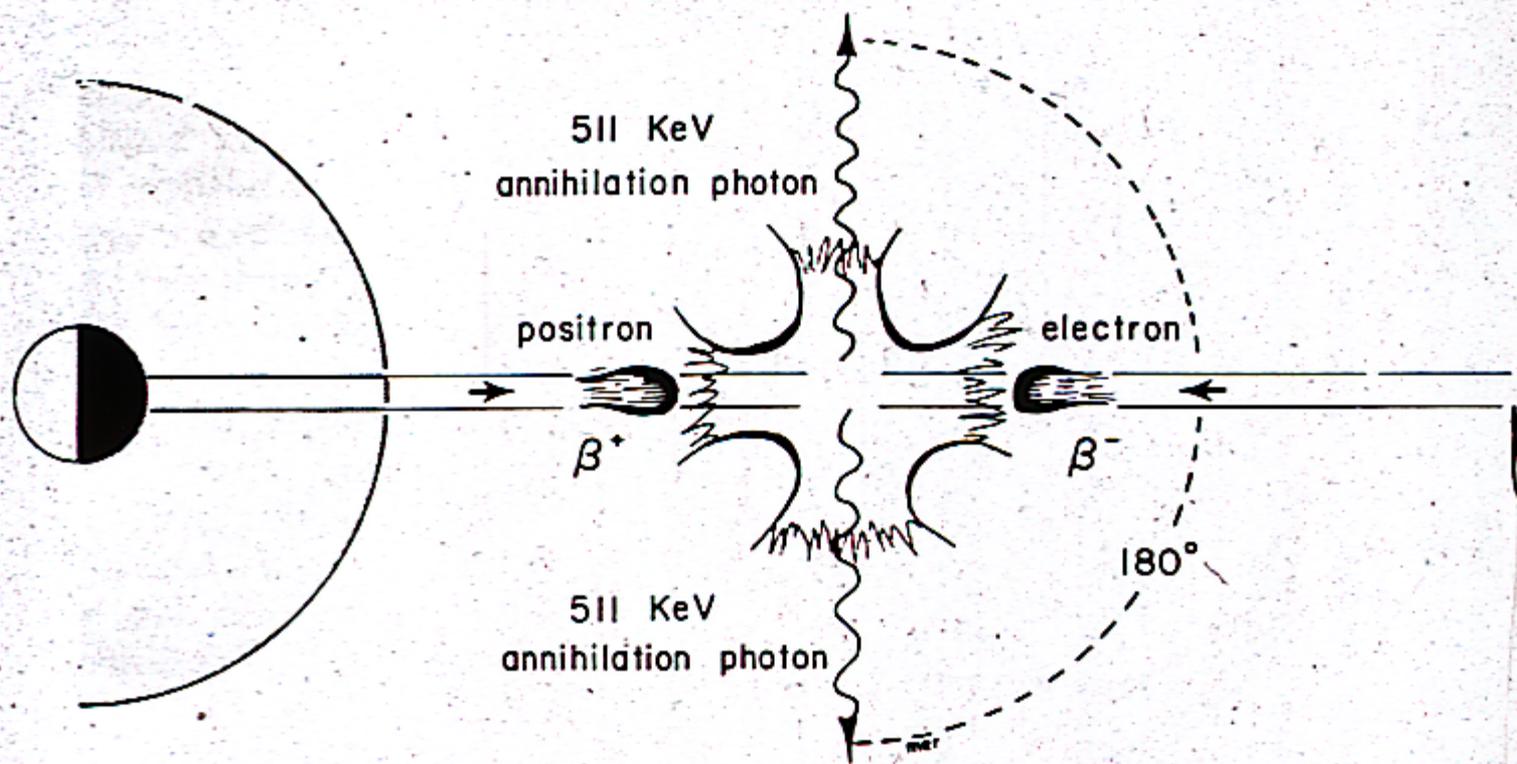


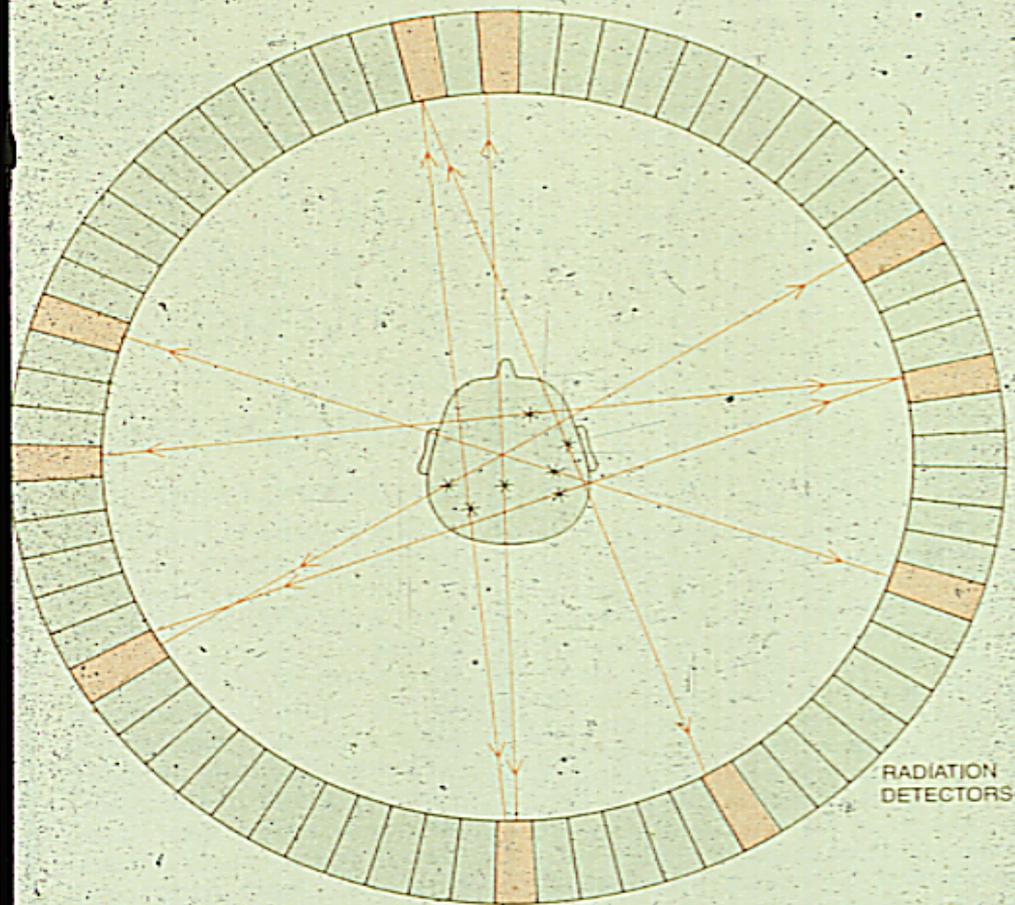


UCI BRAIN IMAGING CENTER



CONTROL

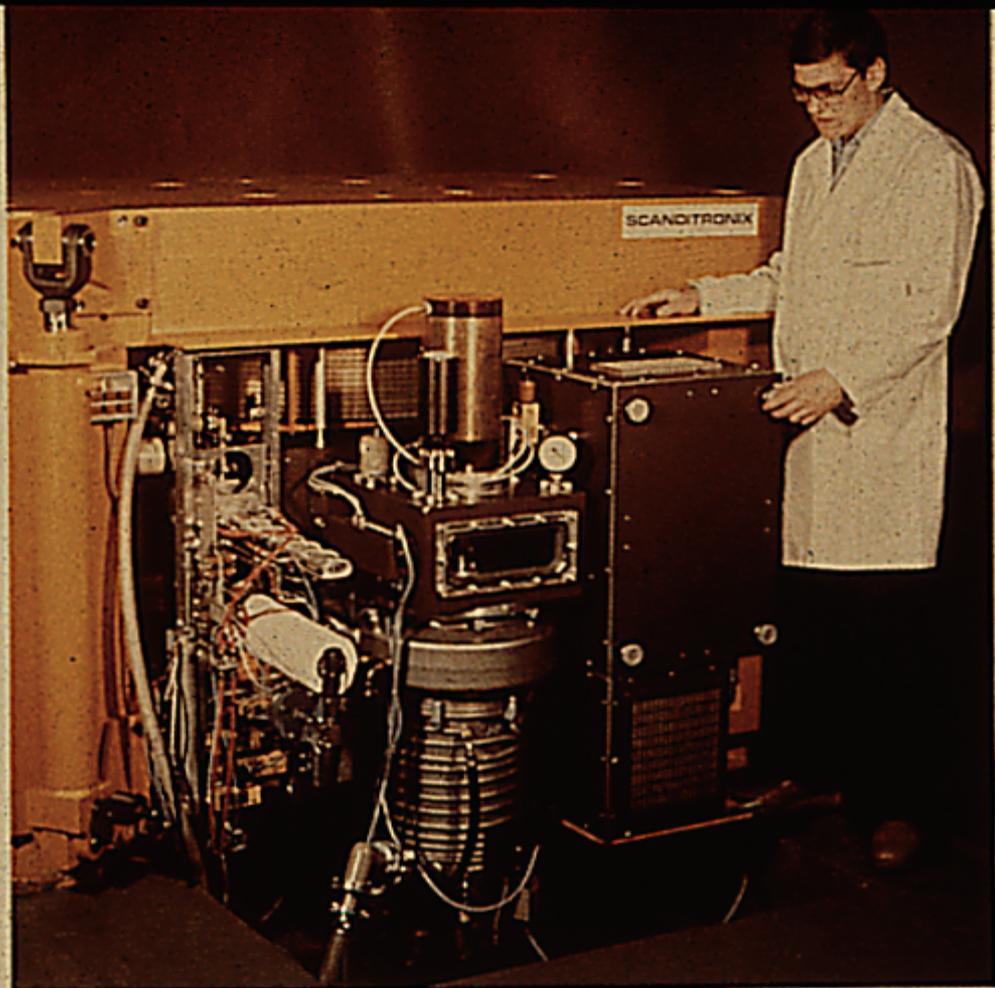




RADIATION
DETECTORS

DISTINGUISHING FEATURE OF A PET SCAN is that the penetrating radiation originates within the subject rather than from the outside. The source of radiation is carried to the tissue of interest by a biologically active compound that has been labeled with an isotope that decays by emitting a positron. The positron and an electron annihilate each other within a few millimeters of the decay site. The detectors are arranged so that only simultaneous events 180 degrees apart are recorded. A computer program reconstructs the distribution of the decaying isotopes.





MC16 cyclotron with gas target

Table 1. Radionuclides for PET

Radionuclide	Half-life (min)	Positron Decay Events (%)	Daughter Nuclide
Carbon-11	20.4	99.8	$^{11}_5\text{B}$, stable
Nitrogen-13	9.96	100	$^{13}_6\text{C}$, stable
Oxygen-15	2.07	99.9	$^{15}_7\text{N}$, stable
Fluorine-18	109.7	96.9	$^{18}_8\text{O}$, stable
Gallium-68	68.1	90	$^{68}_{30}\text{Zn}$, stable
Bromine-75	101	76	$^{75}_{34}\text{Se}$, radioactive, 118.5d

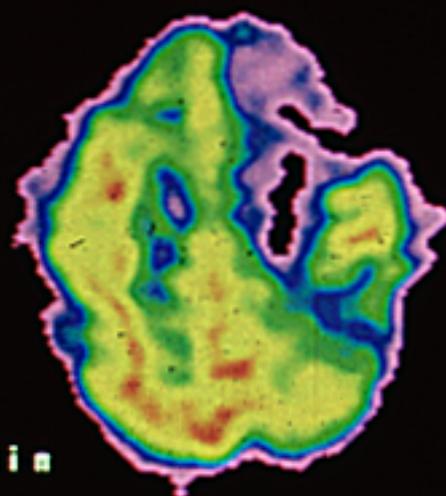




EU1PN3

36.0
32.4
28.8
25.2
21.6
18.0
14.4
10.8
07.2

um/100gm/min

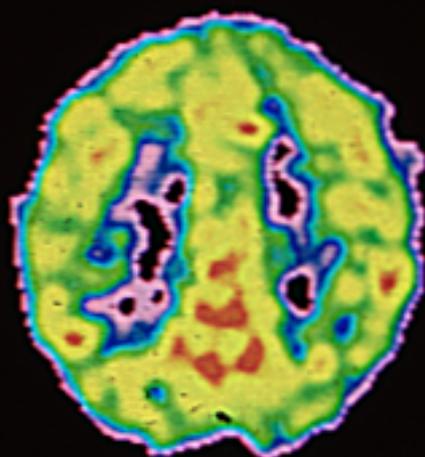


HEAD INJURY

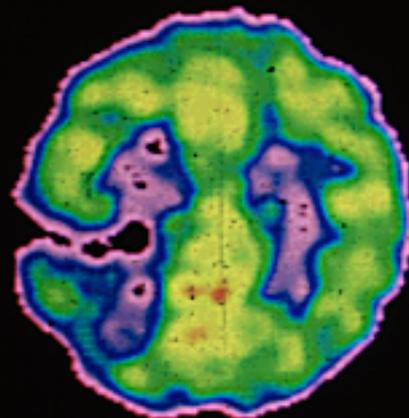
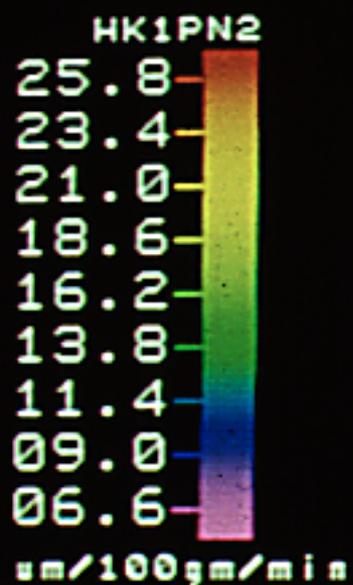
AU1PN3

19.0
17.4
15.8
14.2
12.6
11.0
09.4
07.8
06.2

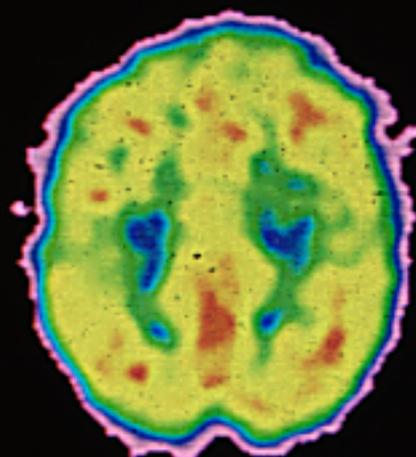
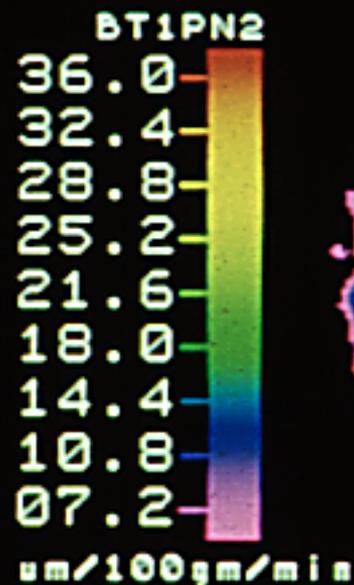
um/100gm/min



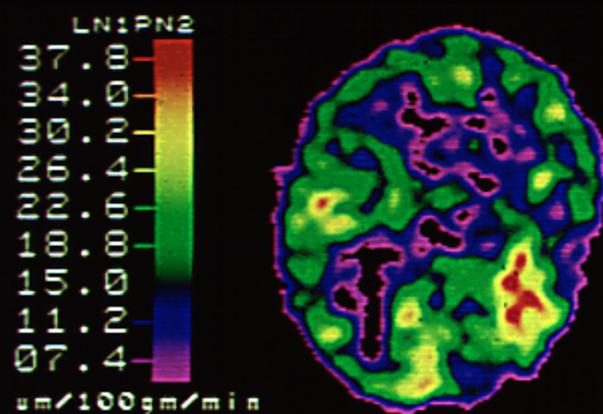
CONTROL



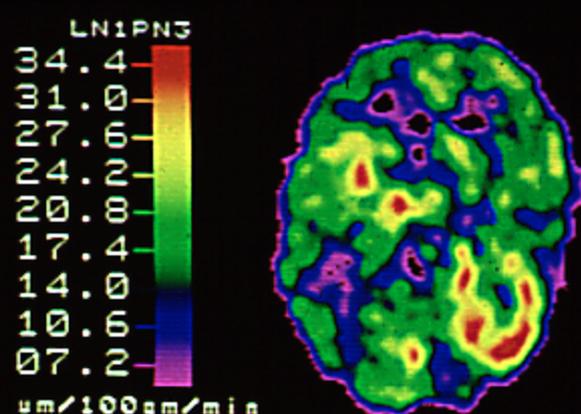
STROKE VICTIM



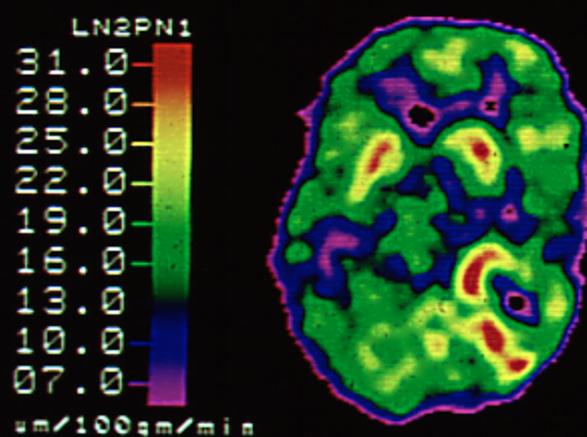
CONTROL



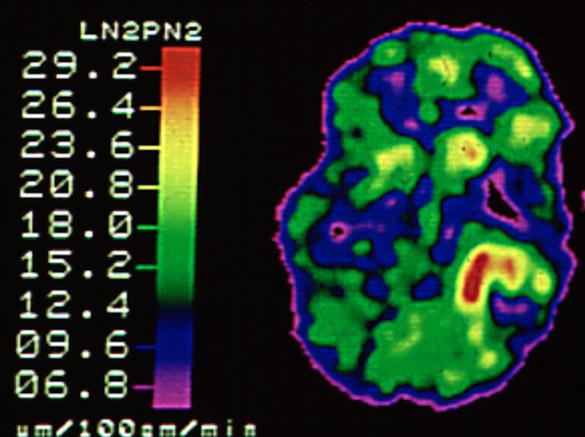
CLINICAL (KG)



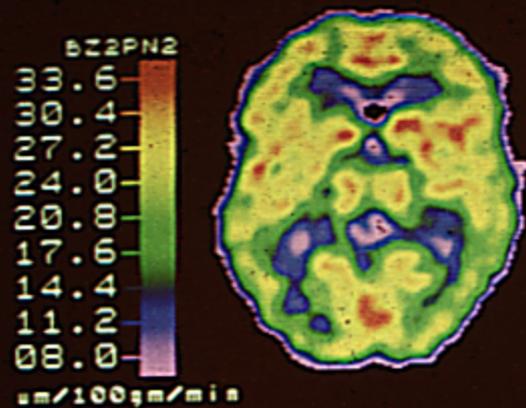
CLINICAL (KG)



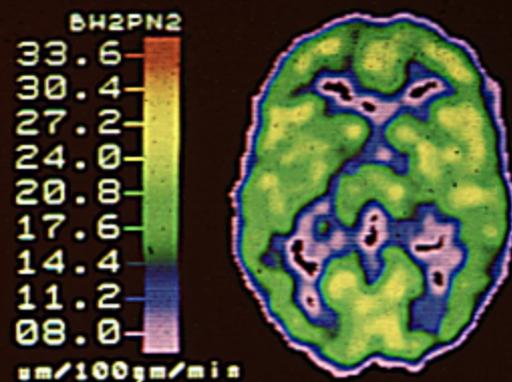
CLINICAL (KG)



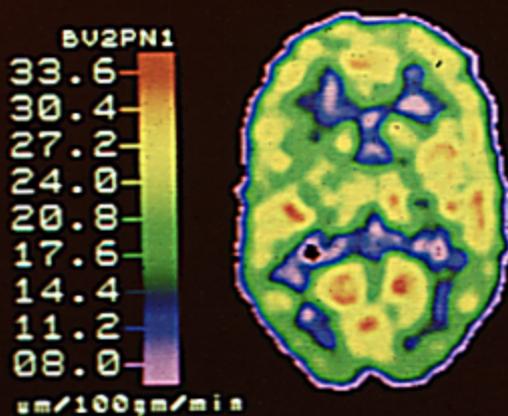
CLINICAL (KG)



REM SLEEP



NREM SLEEP

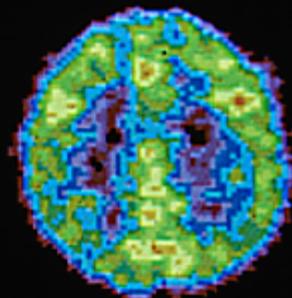
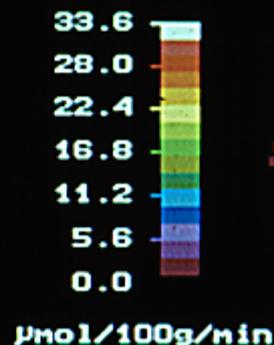
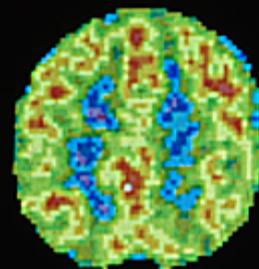


AWAKE

UCI BRAIN IMAGING CENTER

SUBJECT : DP
ATTENTION
PERFORMANCE

UP

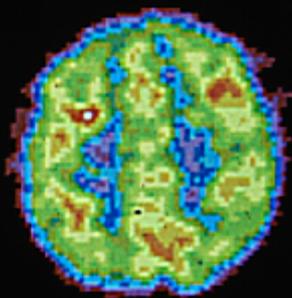
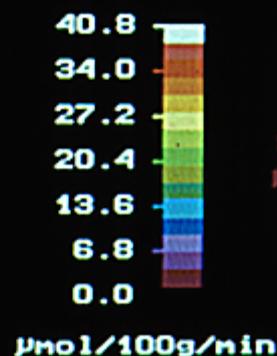
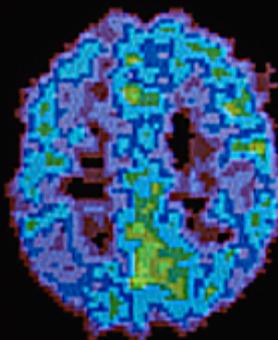


ALCOHOL

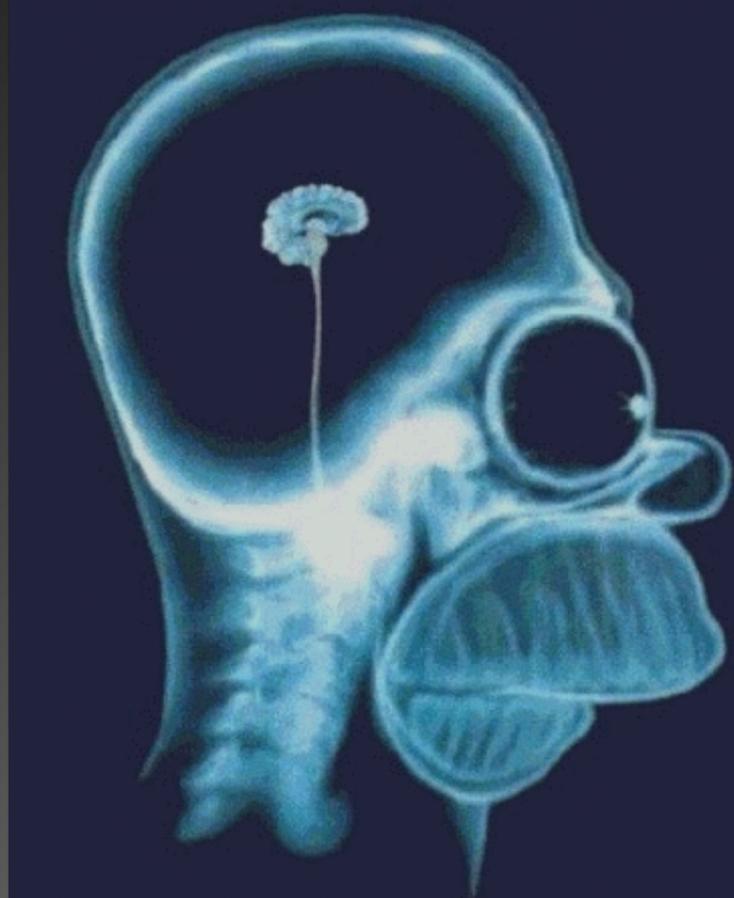
PLACEBO

SUBJECT : KH
ATTENTION
PERFORMANCE

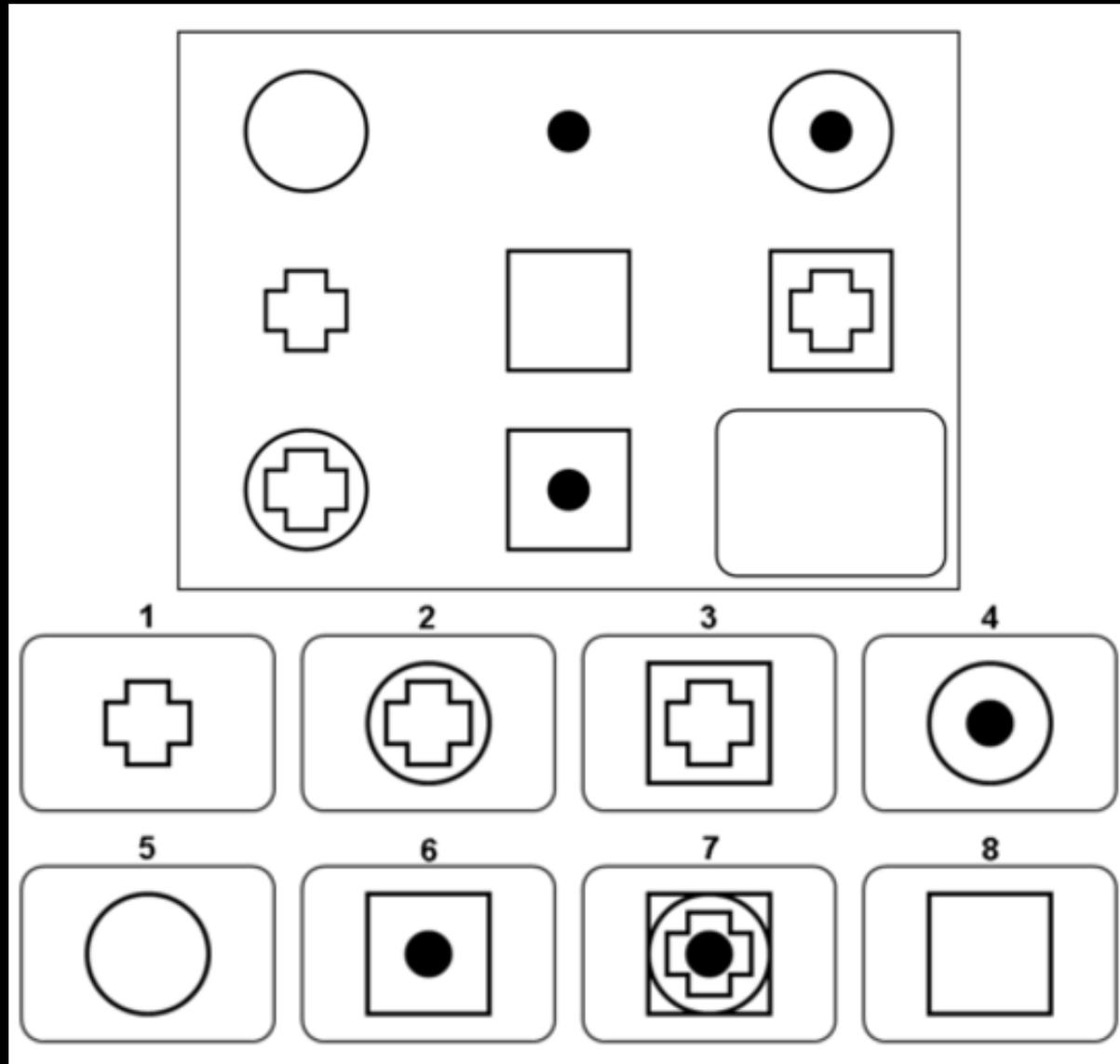
DOWN



Where in the brain is intelligence?

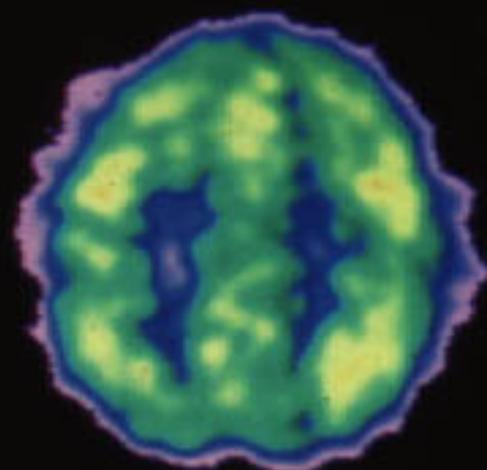
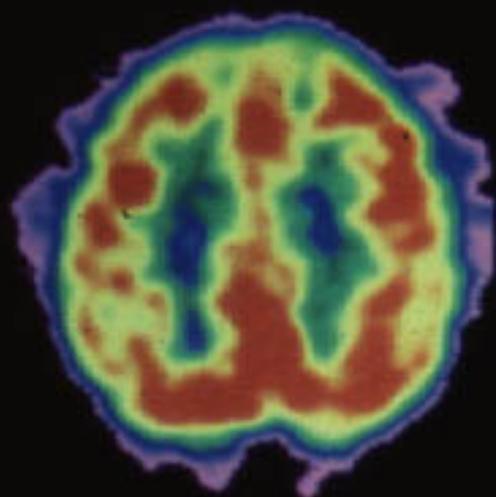


Ravens Progressive Matrices (“g”)

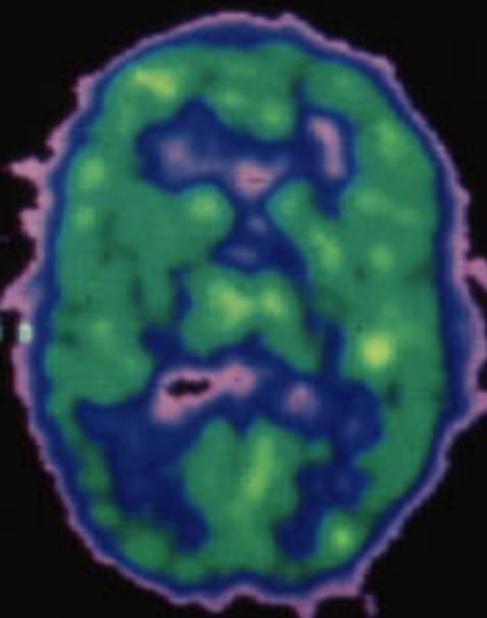
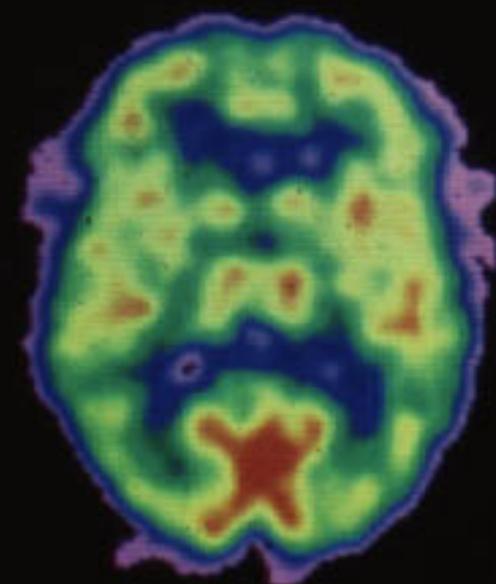


RAVENS = 11

RAVENS = 33



SUPRA





BRES 17361

Regional glucose metabolic changes after learning a complex visuospatial/motor task: a positron emission tomographic study

Richard J. Haier, Benjamin V. Siegel Jr., Andrew MacLachlan, Eric Soderling, Stephen Lottenberg and Monte S. Buchsbaum

Department of Psychiatry and Human Behavior, University of California, Irvine, Irvine, CA (U.S.A.)

(Accepted 29 August 1991)

Key words: Learning; Intelligence; Fluorodeoxyglucose; Positron emission tomography; Glucose; Brain efficiency

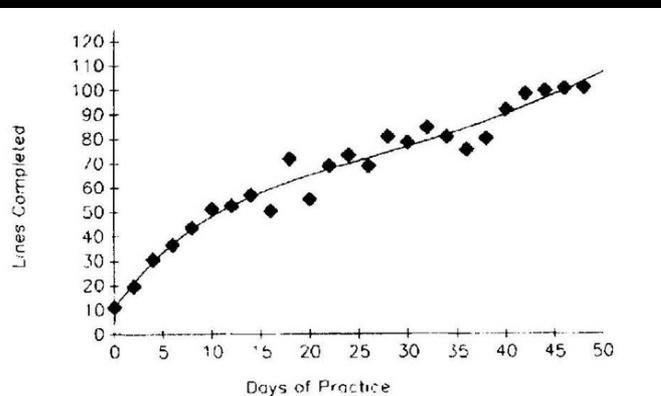
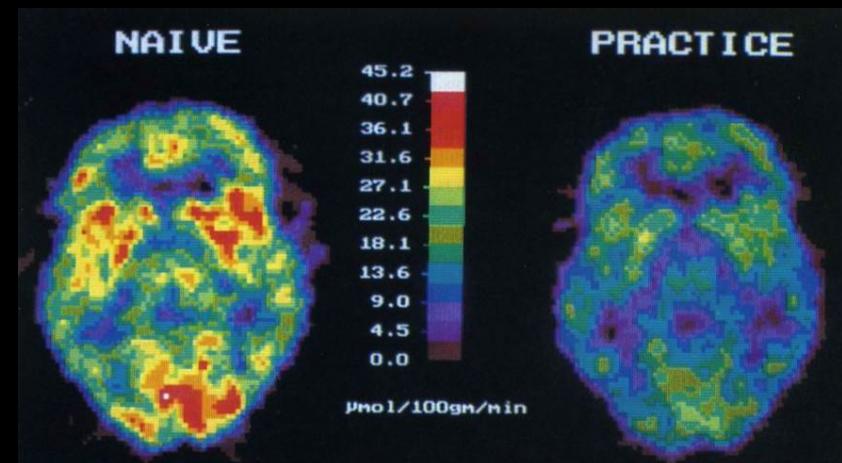


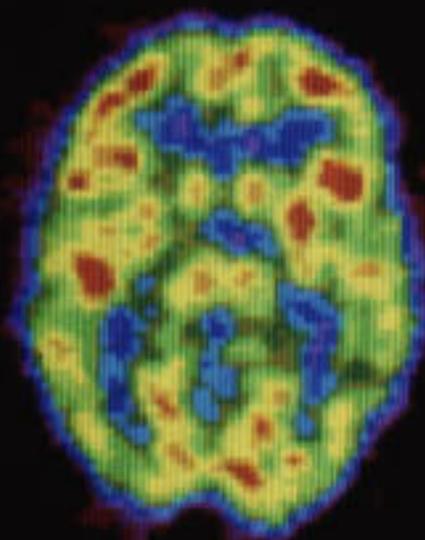
Fig. 2. Tetris learning curve. Plots average score (lines completed) at each practice session. Some later sessions included fewer subjects.



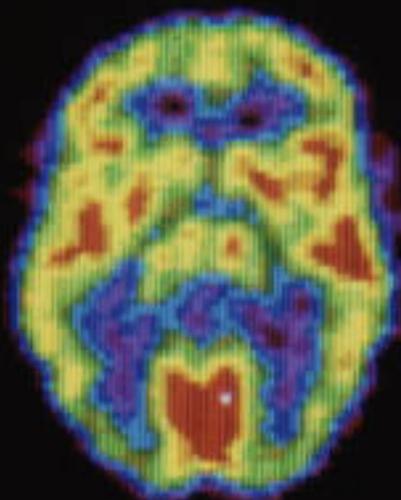
MENTALLY
RETARDED

DOWN'S
SYNDROME

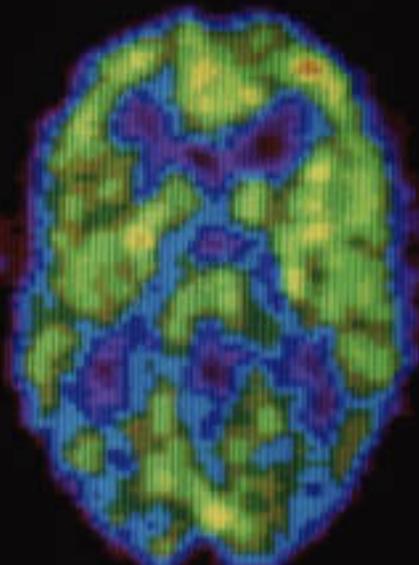
NORMAL
CONTROL



N = 9
CORTEX MEAN = 47



N = 7
CORTEX MEAN = 46

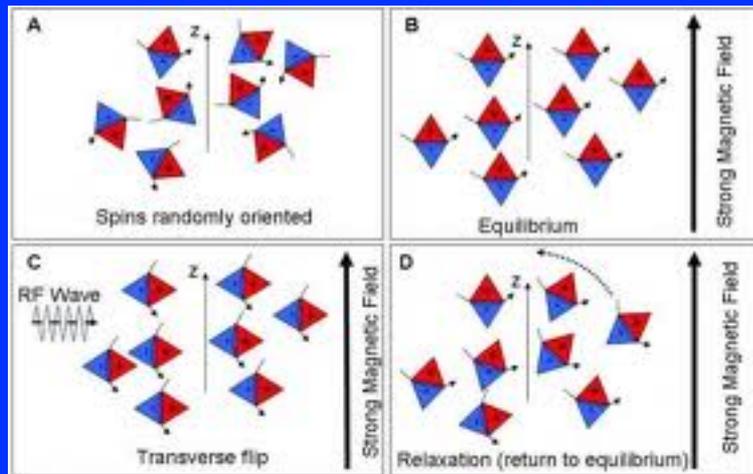
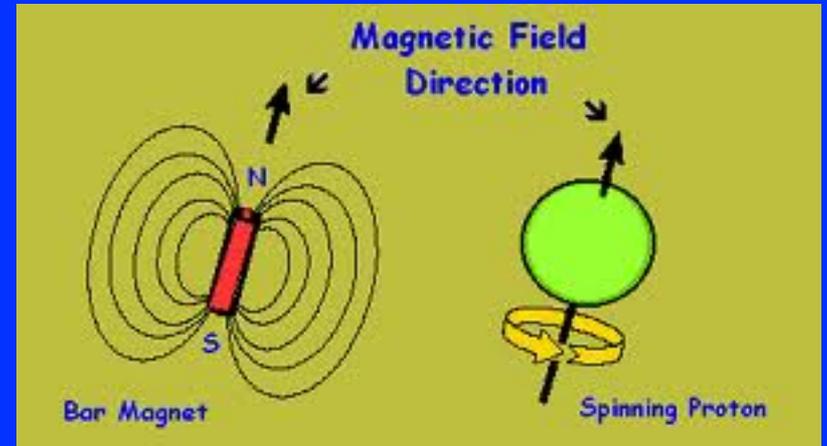
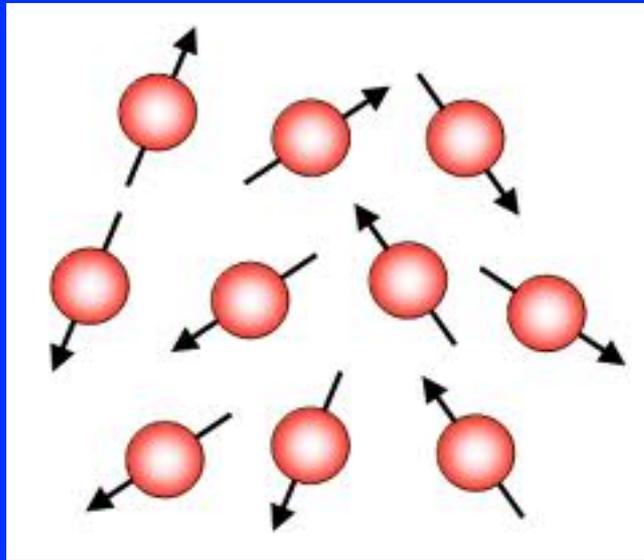


N = 10
CORTEX MEAN = 36



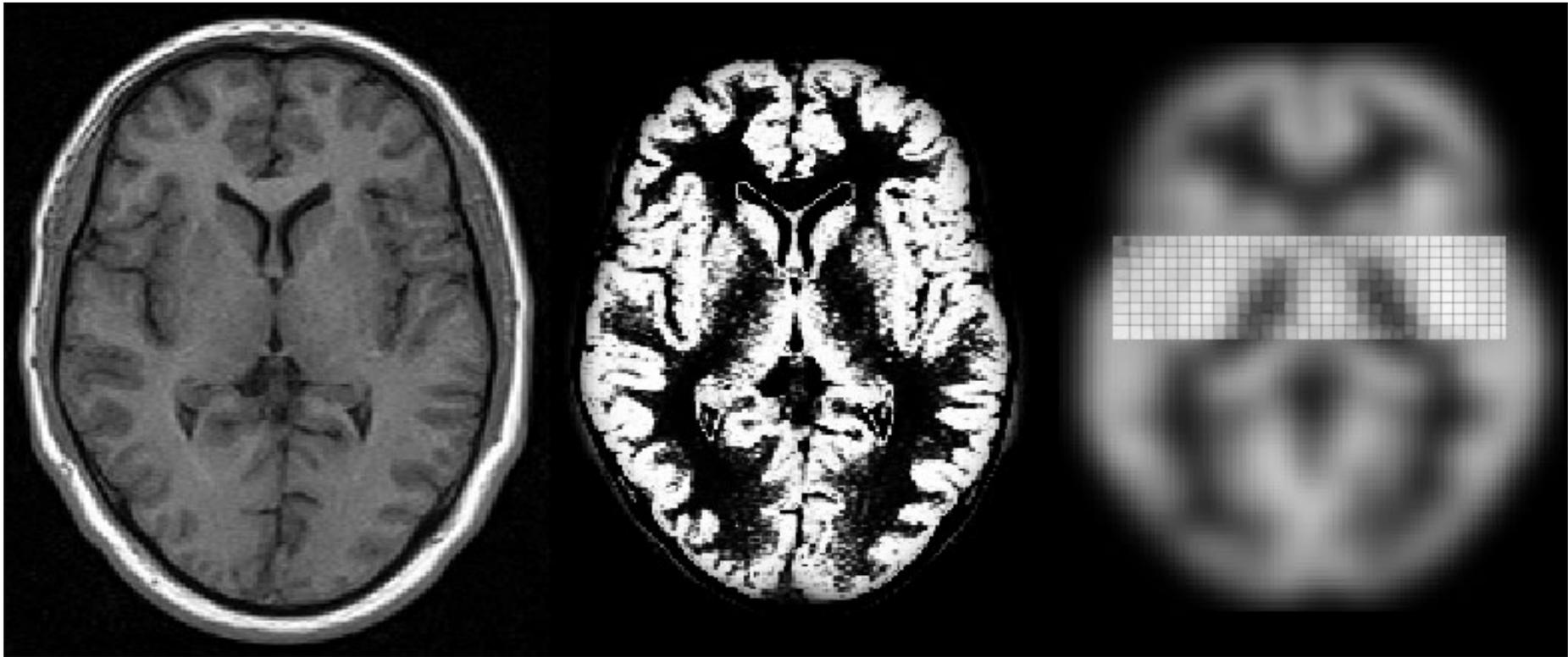
(ANOVA F = 3.27; P = .05)



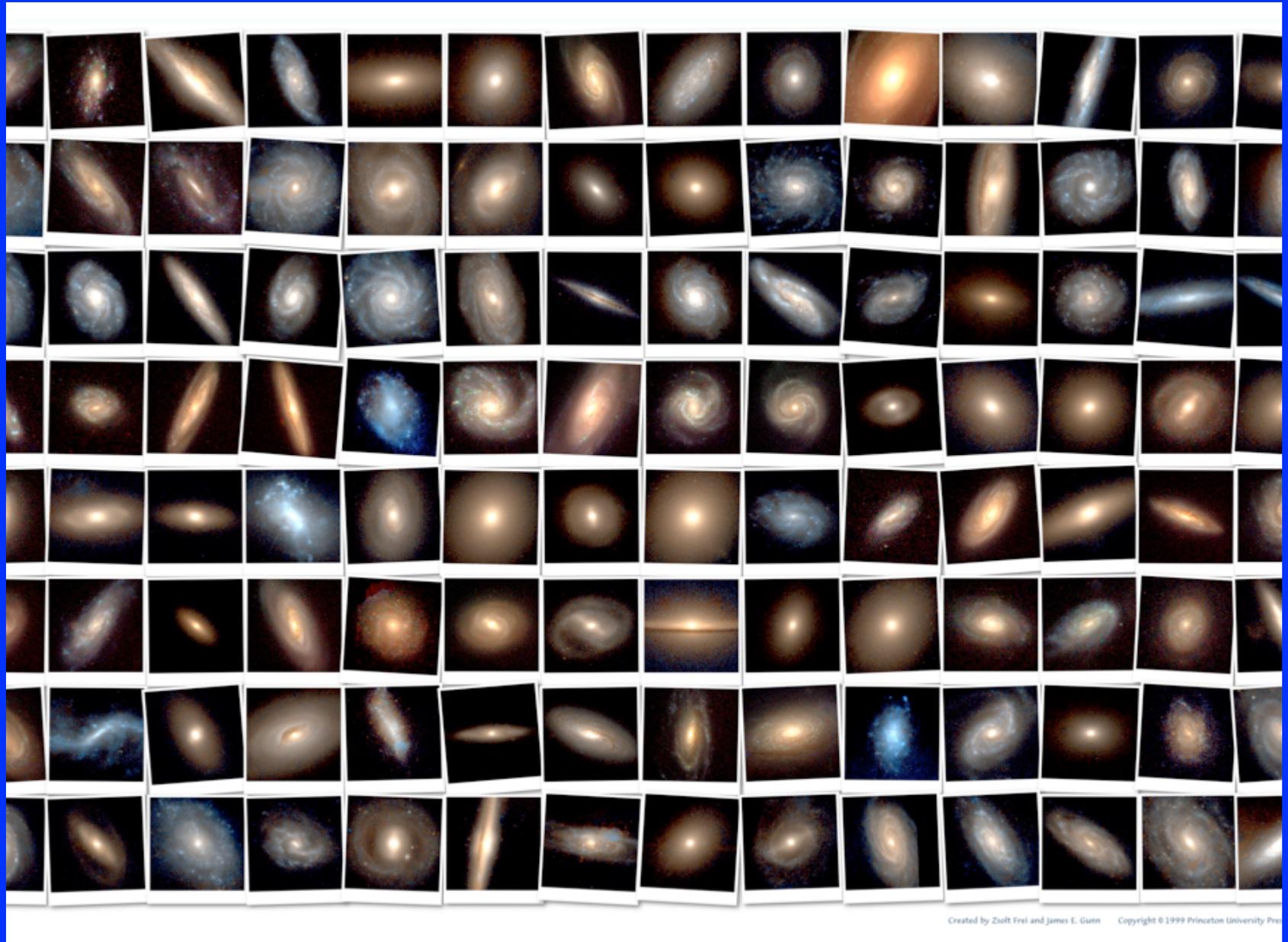


A Brief Primer on Voxel Based Morphometry

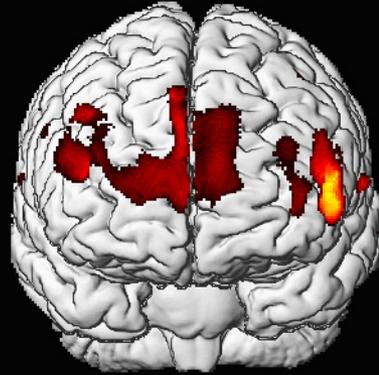
VBM is a segmentation algorithm that segments structural MRI T_1 images into gray matter, white matter, and cerebrospinal fluid compartments, determines the percent tissue (gray, white, csf) on a voxel by voxel basis, and correlates an external measure (e.g., IQ) to regional variations of tissue density.



Slide provide by Jenny Greene



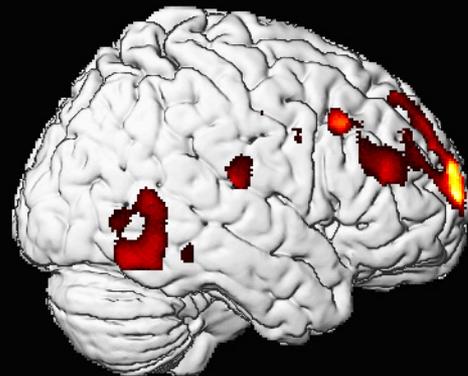
IQ/Gray Matter Correlations



**Frontal
Lobe**

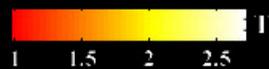
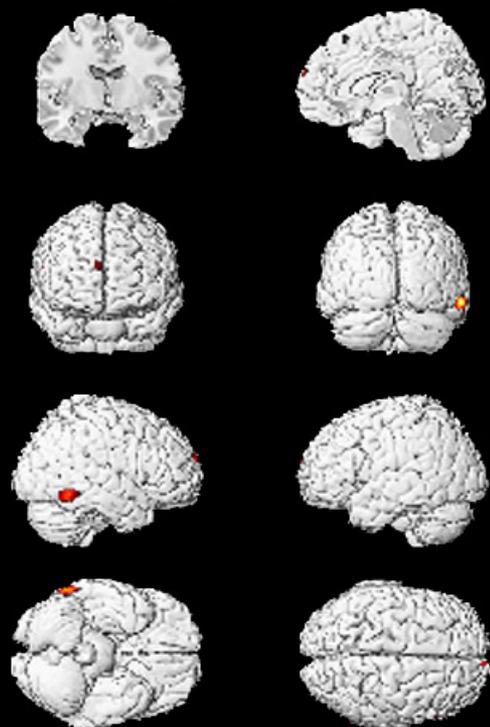


**Left
Hemisphere**

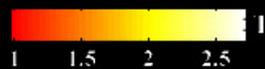
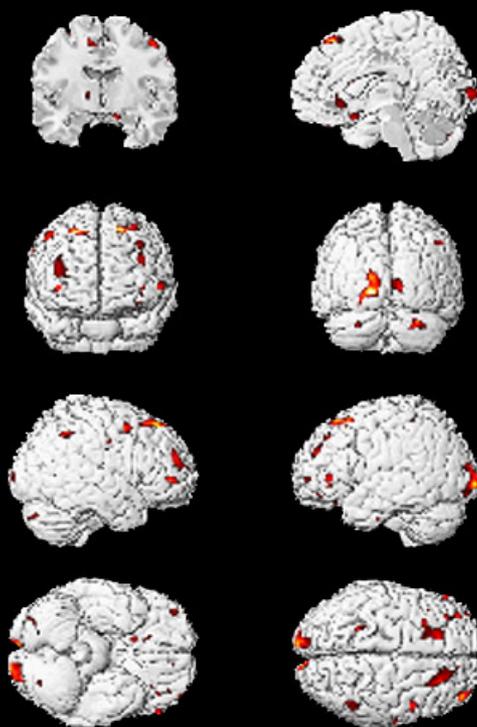


**Right
Hemisphere**

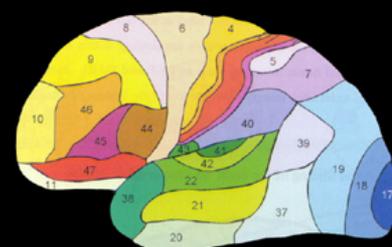
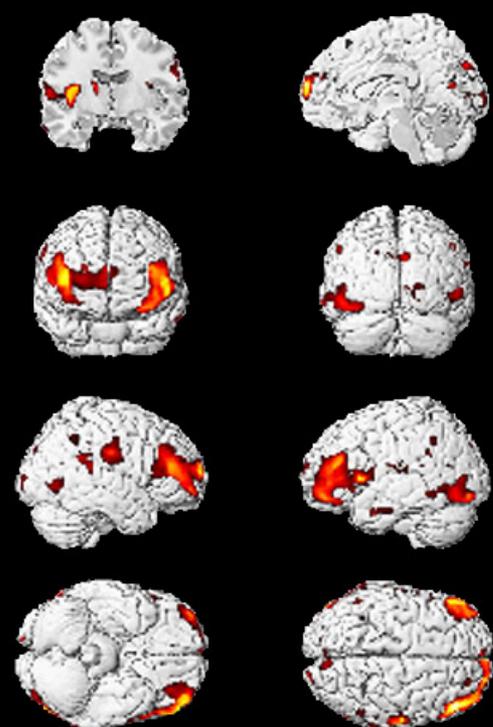
Digit Symbol

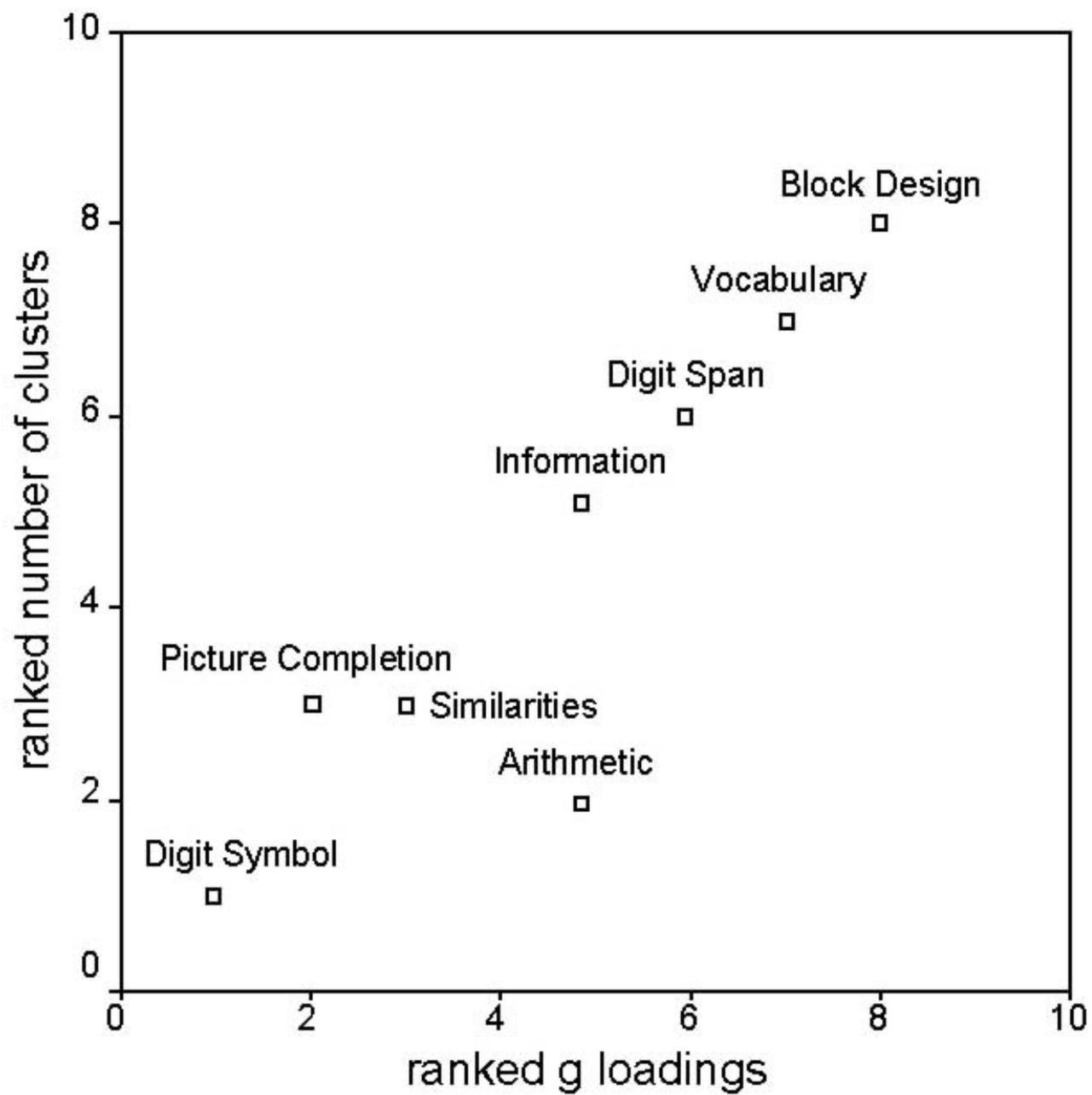


Picture Completion

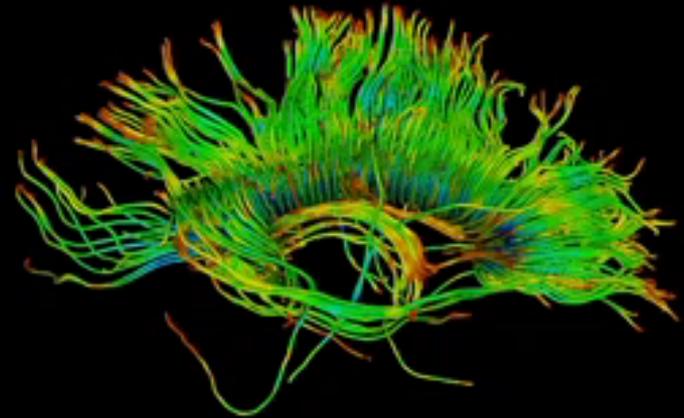
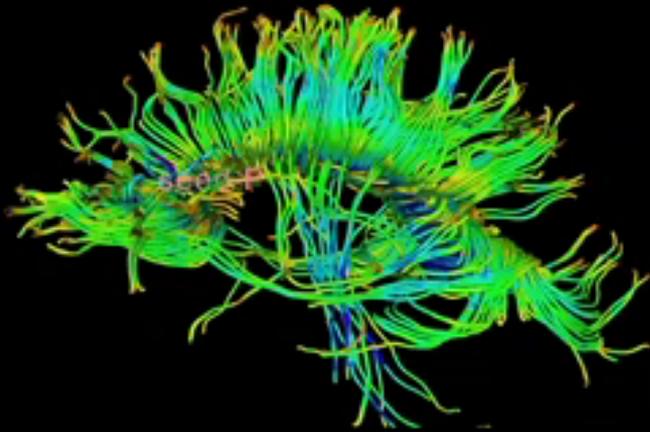


Block Design

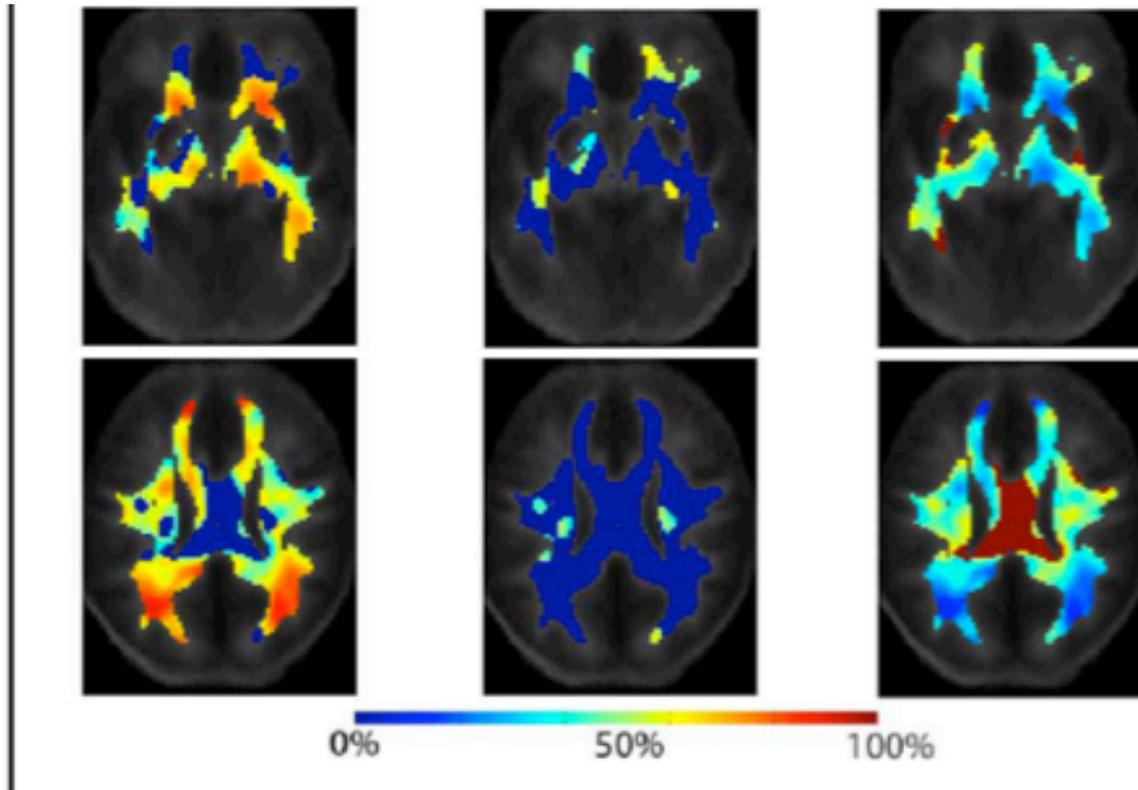




White matter study of the corpus callosum---the cc are white matter fibers that connect the right and left hemispheres



Chiang 2009 – common genetic & environmental variance for IQ/white matter



Barcelona

reminder of a dumb thing a did (birds
and pick pockets)

END SESSION 2

Next time:

What makes a brain smart?

www.richardhaier.com