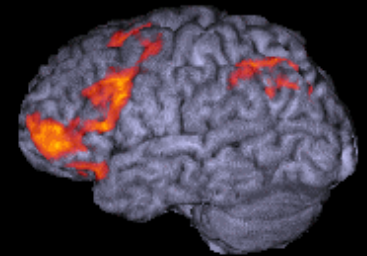


Giftedness and the brain

Day 2

Session 1: 1000-1130

- What is the neural basis of intelligence?
 - IQ test
 - Intelligent thinking
- How are gifted children's brains different from others?
 - When doing hard stuff
 - When doing dumb stuff



Neurophysiological advantages of gifted children

Gifted children process information more rapidly and with less attenuation than others.

Such individual differences can be attributed to neurophysiological differences that affect neuronal efficiency.

Geake (1997)

IQ-related differences in neurophysiology of frontal areas

Post mortem analyses show the density of neurons and gliocytes and the thickness of cortical layers in frontal areas BA 8 and 47 in people with high IQ of different ages exceed (more than double) those of controls.

Orzhekhovskaia (1996)

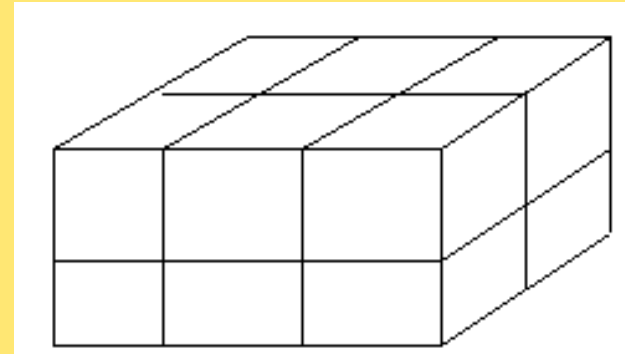
Iowa study of mathematically precocious youth (1)

Subjects: mean age = 13 years
SAT Math > 1300 (/1400)
top 0.5% of IQ distribution

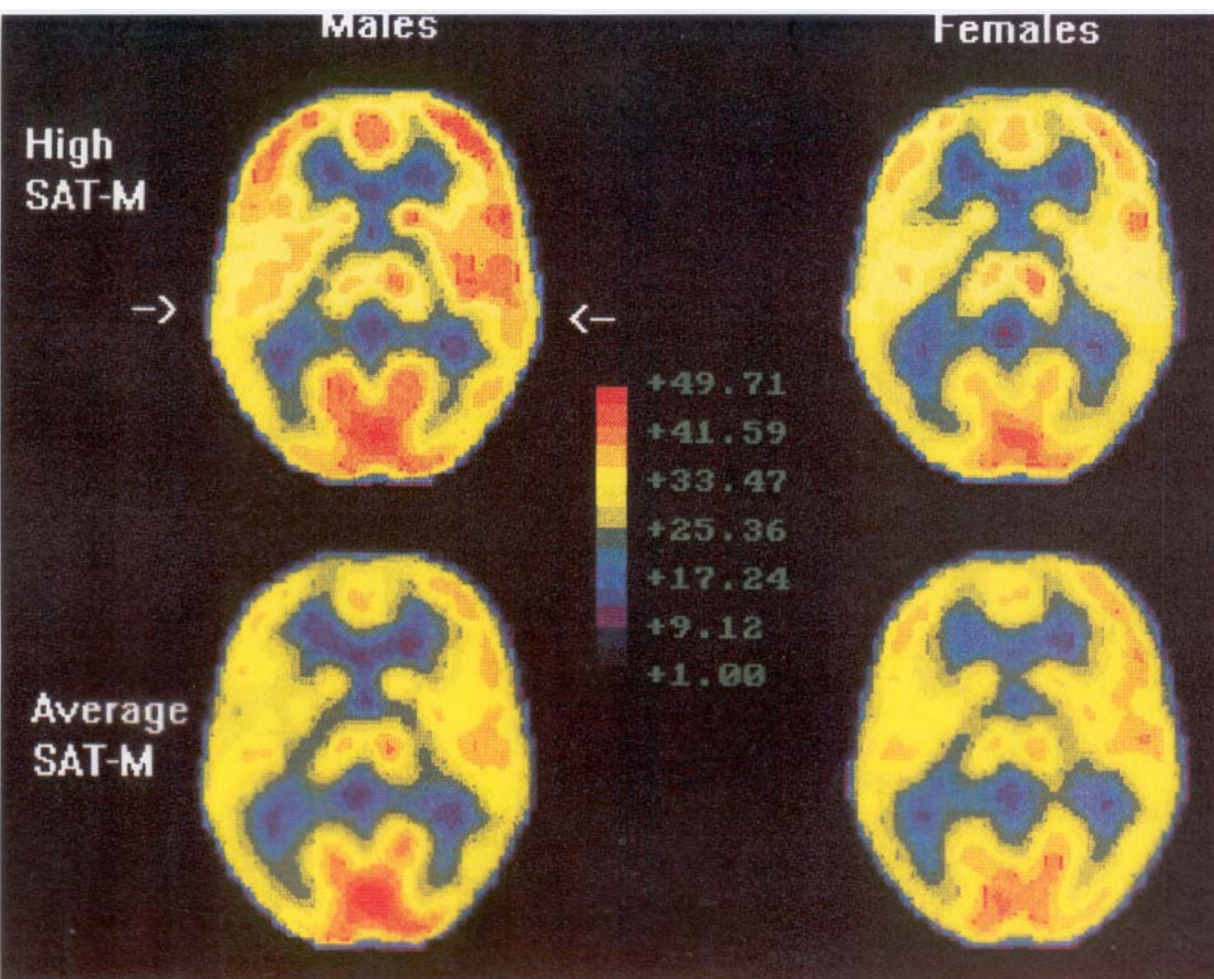
Task: SAT Math questions

Method: PET blood glucose metabolism

Hypothesis: differences in frontal function



The solid brick shown is made of small bricks of side 1. When the large brick is disassembled into its component small bricks, the total surface area of all the small bricks is how much greater than the surface area of the large brick?



Precocious individuals were more active in the frontal lobes, suggesting the frontal lobes mediate high-level intelligence.

Neural correlates of musical abilities

How does the brain play music?

Why Mozart?

Mozarts vs. normal children: estimations of musical self-coherence

neuropsych dimension	implied functional area	explained variance
successive synthesis	temporal cortex	11.6%
simultaneous synthesis	parietal cortex	2.3%
executive attention	frontal cortex	23.4%

For gifted young musicians, it is their superior use of executive or metacognitive strategies [mediated by the frontal cortex], such as inward-directed attention, that contributes most towards their remarkable abilities.

Geake (1996)

Musically talented vs. normal adults: Hausdorff dimension of frontal EEG

	pseudo- classical high musical complexity	pseudo-jazz medium musical complexity	pseudo-rock low musical complexity
Musically talented	highest	intermediate	intermediate
Unmusical	intermediate	intermediate	lowest

Birbaumer et al (1994)

Complex music produces complex brain activity in complex people, simple music excites simple brain activity in simple people

Birbaumer, Lutzenberger, Rau, Mayer-Kress,

Choi & Braun (1994)

Individual differences

genetic differences contribute to individual differences in anatomy and physiology, including neuroanatomy and neurophysiology, which in turn contribute to individual differences in psychology

Genetic variance through twin studies

- monozygotic (MZ) twins = identical twins
 - share 100% of their genes
 - zygote division post fertilisation
- dyzygotic (DZ) twins = fraternal twins
 - share 50% of their genes
 - two zygotes are fertilised

Table 2 Within-Age MZ and DZ Cotwin Familialities, Group Heritability (h_g^2), and Group Common Environmental (c_g^2) Estimates

Variable	Familiarity				h_g^2	c_g^2
	MZ	n_{MZ}	DZ	n_{DZ}		
14 months	.33	26	.41	40	.00	.33
20 months	.77	21	.63	39	.28	.49
24 months	.76	37	.56	32	.40*	.36
30 months	.71	25	.39	27	.64*	.07

Motor skill acquisition of twins

day	performance	heritability
1	20%	55%
2	45%	65%
3	60%	70%

Fox, Hershberger & Bouchard, 1996

Most genetically determined behaviours are predispositions

the child creates the circumstances in which to preferentially thrive

predilection for reading e.g. Dahl's *Matilda*, not necessary to have books in the home

Plomin (1987)

- genetic differences among individuals contribute to measures of the environment
- the genetic contribution to measures of the environment is greater for measures of active experience
- the genetic contribution to measures of the environment is due in part to psychological traits
- genetic differences among individuals contribute to differences in experience independent of psychological traits

Summary

- genetic inheritance is central to cognitive ability, and becomes more so across the life span
- environment also matters because it is the most direct way of influencing the child, and as this is a small part, it is more sensitive, not less, to deprivations
- nature-nurture is a dialectic