Psych 3102
Introduction to Behavior Genetics

Lecture 20

General Cognitive Ability – Developmental aspects

1. Changes in heritability during development

- does similarity between relatives change over time?

2. Influence of genes on development

- do genes contribute to any changes?

3. Locating genes involved in general cognitive ability

- many genes of small effect, can methods be developed to allow them to be located?

1.Changes in heritability during development

- genetic influence seems to become more important over time
- gene expressive seems to vary over a lifetime

Evidence from family studies Colorado Adoption Project

- longitudinal study of parents and offspring
- measured for cognitive ability from infancy to adulthood

	Correlations	
Relationship	Infancy	Adolescence
Parent/offspring	0.18	0.30
AdoptiveP/offspring	0.08	0.03
BiologicalP/offspring	0.12	0.37

- indicates gene influence increases over course of development
- little evidence for persistent effects of shared environment

Evidence from twin studies

Minnesota Twin Study

- comparison of MZs and DZs reared together, birth to adulthood

MZs and DZs start with more similar correlations (0.79, 0.59)

but difference goes up slightly early → mid-childhood (0.82, 0.59)

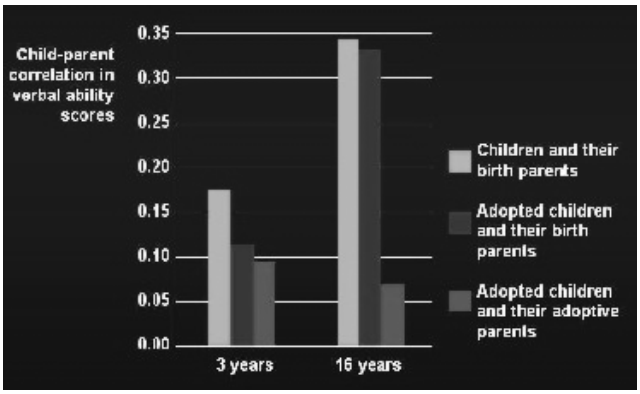
then up considerably into adulthood (0.86, 0.39)

Louisville Twin Study – similar study with similar results

- also supported by adoption studies (look at overheads)
- the older the subjects in the sample, the higher the heritability (average $h^2 = 0.75$ after adolescence)

Swedish Twin Study

MZ twins age 60, reared apart $h^2 = 0.80$ replicated



- all evidence points to increasing heritability with age

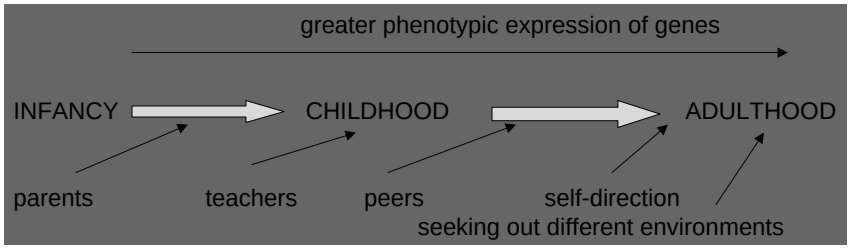
- **why?**

different genes expressed at different ages?

full phenotypic effect of genes not shown until adulthood?

lessening of environmental influences with age?

genotype/environment interaction may reinforce genetic differences



2. Influence of genes on development

- do genes influence changes in g over time?

Evidence indicates expression of genes changes over time

- some gene effects can only occur when certain developmental milestones are reached

genes affecting processes involved in language

Evidence from longitudinal studies model-fitting analyses

Fulker et al (1993):

2 transition stages:

1. infancy → early childhood LANGUAGE DEVELOPMENT
2. early → mid-childhood FORMAL SCHOOLING

- most gene effects contribute to continuity, not change, over time
- some gene effects contribute to changes in the transition stages

3. Locating genes for general cognitive ability

- many genes of small effect for cognition in normal range
- most success so far in locating genes with severe effects

many mutations that cause retardation do NOT seem to occur in genes that normally influence cognitive processes

one aim is to work out biological basis of cognition – these mutations do not help in this

Methods used:

knock-out gene studies in animals (eg.mice)

allelic-association studies of candidate genes in humans

full genome-scan linkage analyses in humans – but power is weak

Boosting power to detect loci of small effect

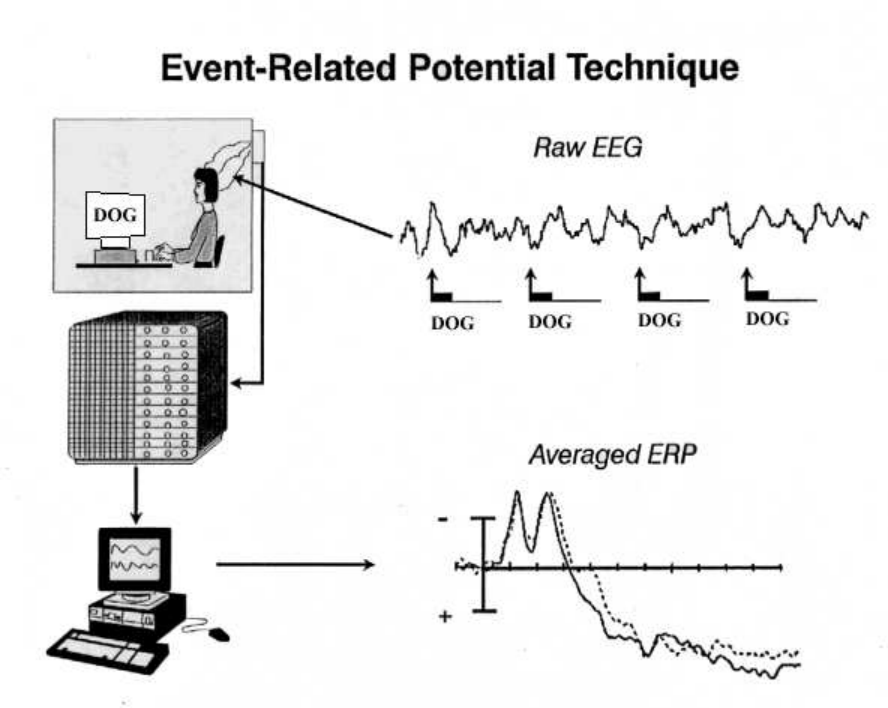
- use a HUGE sample 30-40,000 people

\+ use many thousands of markers spread across genome

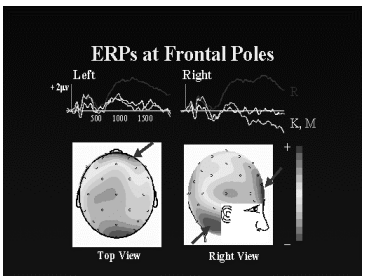
- use an endophenotype – a simpler, more easily-measured component of the larger phenotype

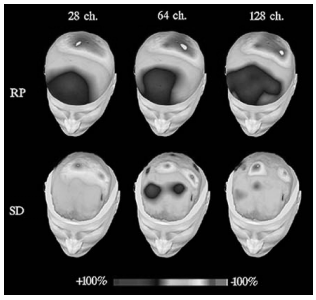
for cognition: information-processing speed as measured by
reaction time or working memory capacity
electro-physiological measures of brain function
such as event-related potentials (ERPs)

- to be useful, these endophenotypes must be:
  1. correlated with g
  2. influenced by genes (heritable)



Event-related potentials





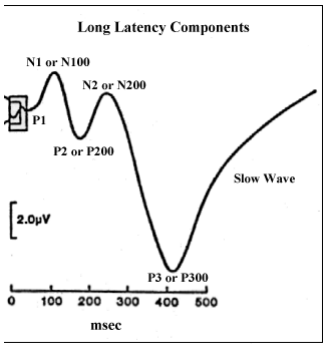
P300 (P3) brain potential

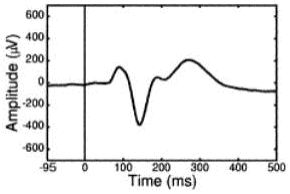
- large waveform, peaks (starting at ~ 300mS) after detection of attended & task-relevant stimulus

typical task: count infrequent relevant stimuli randomly appearing among irrelevant stimuli

- latency measures evaluation time
- amplitude gives measure of working memory resources allocated by brain

(a measure of information processing)





decreased amplitude – schizophrenia, alcoholism

Candidate loci for cognition

Morley & Montgomery (2001)

76 candidate genes implicated in human cognitive processes:

- 4 memory
- 17 learning
- 30 general cognition
- 29 mental retardation

+ many more in mice, Drosophila

only 1 locus found in all species so far NF1

ras-specific GTPase activating protein