The concept of general intelligence

Vocabulary: Indicate the meaning of words. For example, *table* (easy), *persuasive* (medium), *obfuscate* (hard).

Similarities: Indicate what is common about two words. For example, in what way are *peach* and *plum* alike? In what way is a *sculpture* and a *symphony* alike?

Information: General knowledge. For example, name three oceans, who wrote the *Tempest*?

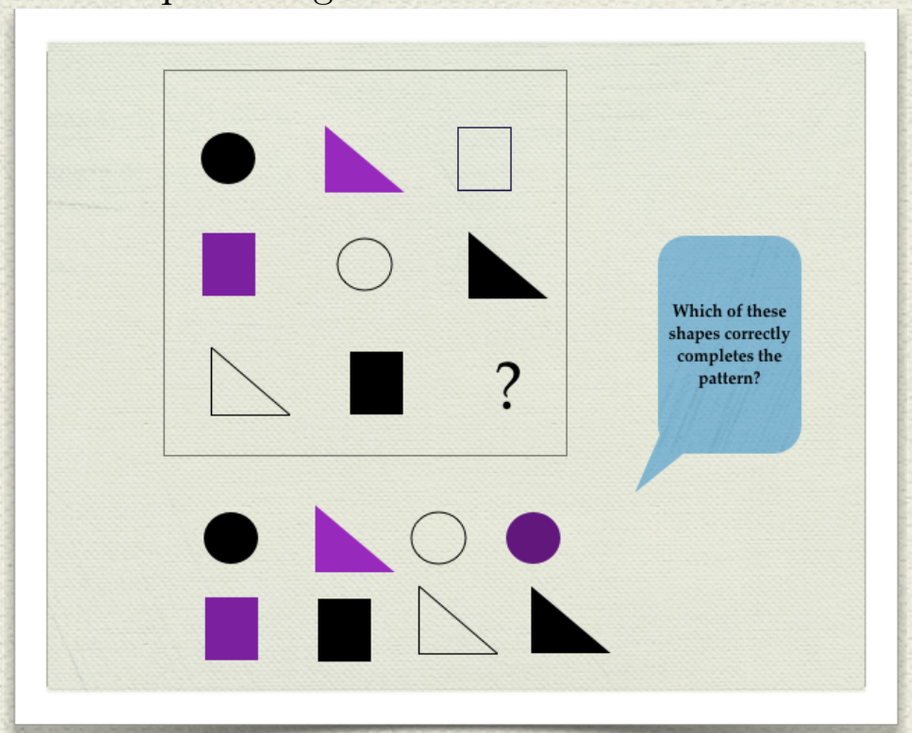
Comprehension: Questions dealing with everyday situations, as well as understanding of proverbs. For example, *why do you need a driver's license*; *what does it mean to say: too many cooks spoil the broth*?

Picture completion: Spot the missing piece in a sequence of colored drawings. For example, spokes are missing in the wheel of a bicycle. The questions become progressively harder.

Block design: Look at a two-dimensional pattern made up of red and white squares and triangles, and reproduce the pattern with solid cubes to red and white faces. The patterns become harder over trials.

Picture arrangement: Place a series of cartoon drawings in the correct order so as to represent a coherent story.

Matrix reasoning: Find the missing element in a pattern that builds up in a logical manner.



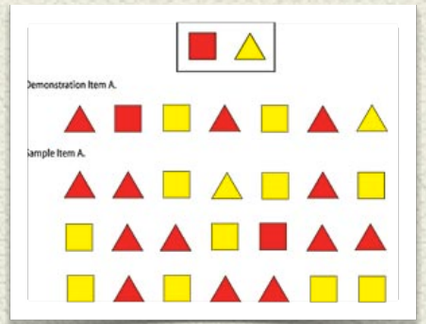
Arithmetic: Mental arithmetic.

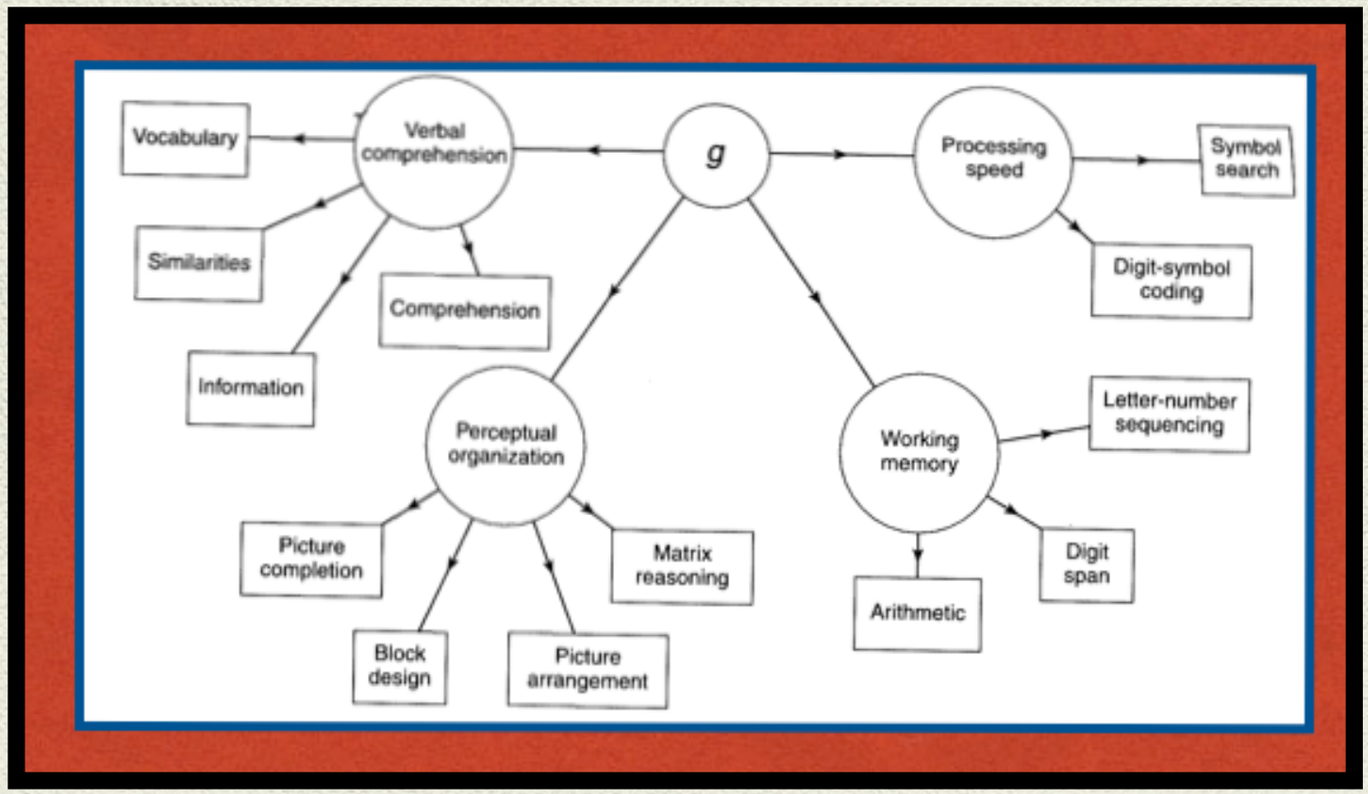
Digit span: Repeat in the correct order a sequence of numbers presented by the examiner. The sequences vary from 2 to 9 digits in length. In a second part of the test, each sequence must be repeated in reverse order.

Letter-number sequencing: The examiner reads a series of alternating letters and digits. They must be repeated, first the digits in numerical order then the letters in alphabetical order. For example, the sequence *F-5-P-7-C-2* should be repeated as *2 5 7 C F P.*

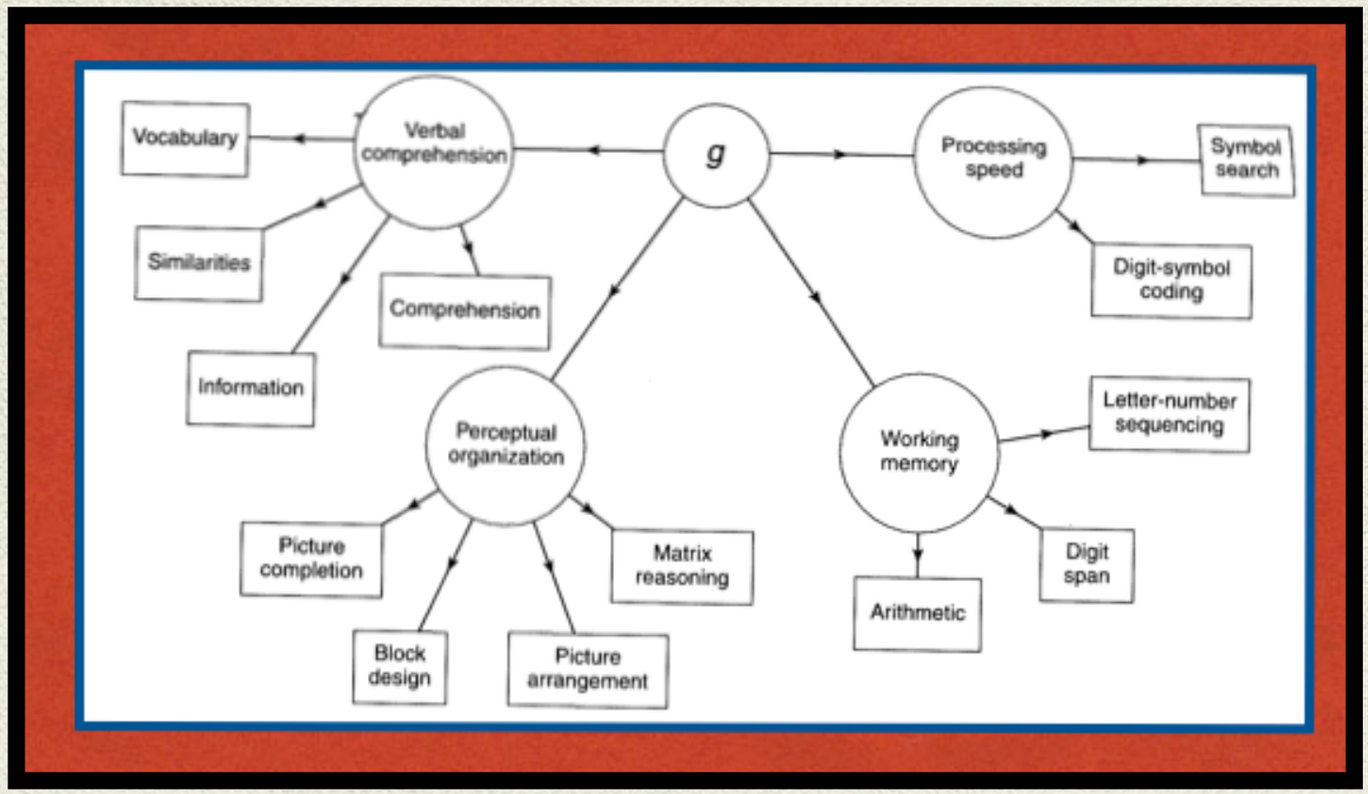
Digit-symbol coding. Write down the number corresponding to a given symbol. The test requires completion of as many pairs as possible in 90 seconds.

Symbol Search: Find (by drawing a line through it) every symbol in a list that corresponds to either one of a given pair (in the example, a *red square* and a *yellow triangle*). Thus, a *red square* occurs in the first sequence labeled *Demonstration Item A,* a *yellow triangle* occurs in the first line of Sample Item A, etc. The test assesses how many target items can be detected in 2 minutes.





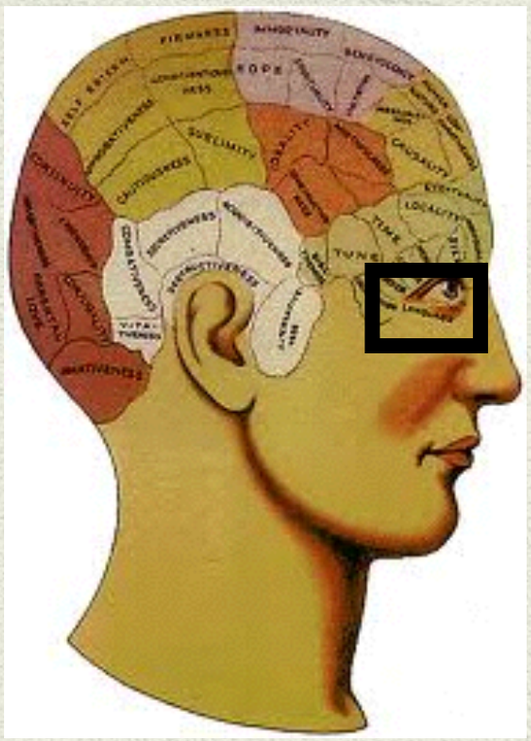
In general, people who do well on one test do well on all the others. But a number of subtests are very strongly correlated. These clusters of highly correlated tests are called ‘group factors’.



Four Group Factors.

Group Factor

Notice that we are not using the term to necessarily imply that we have somehow extracted a *vertical faculty* from a pattern of correlations; working memory, for example, is involved i
manipulating informatic
language, pictured objec



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Do the group factors correspond to functionally distinct sets of mental modules?

Notice that the psychological constructs labelled as Working Memory, Perceptual Organization, Processing Speed and Verbal Comprehension in the diagram on page 94 are *not* based on any clear theoretical understanding of the similarity between tests. Instead, the circles labelling the 4 group factors were derived from statistical correlations.

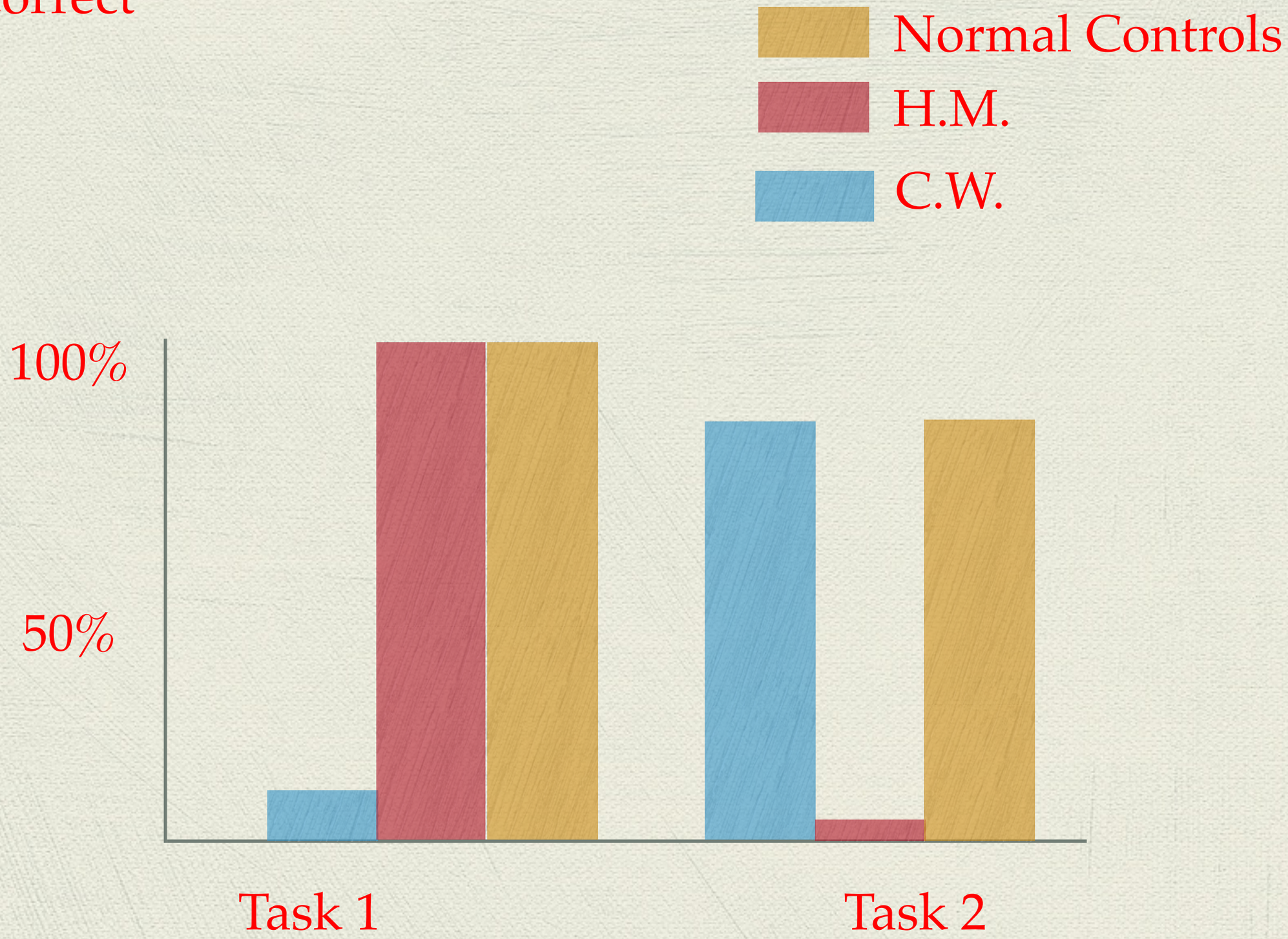
Compare this approach with the evidence for the claim that there is a functional distinction between long term memory and auditory short term memory.

Task 1: Repeat a short set of auditory words in the order presented. e.g. BOOK TREE HAND FARM SMILE

Task 2: Learn a much larger set of auditory words without any regard for their order. e.g. BOOK TREE HAND FARM SMILE TEAM WIFE BREAD LAND CHAIR SWORD FRIDGE

A normal individual can repeat about 5 words in the order presented, and learn a list of 12 words after about four attempts (each time, the list is presented and the subject is given the chance to learn the list).

Percent correct



The g factor

Do people with high scores on working memory also have fast processing speed, and do they also achieve high scores on verbal comprehension and perceptual organization? Indeed, the answer is that these four group factors yield correlation coefficients that are all substantial, varying between 0.6 and 0.8. Individuals who excel on any one factor tend to perform well on the remaining three factors of the WAIS

A hierarchical model of mental ability

At the top of the hierarchy stands *G* or general intelligence, accounting for about *half the variation between individuals* in a large population.

General intelligence refers to a mental ability required to perform *all tests* without regard to their specialized nature.

The diagram on page 94 also indicates that there is more to human intelligence than being generally clever. Different kinds of tasks require *special sets of abilities that clump as group factors*. These factors account for *additional variation between individuals*, beyond the variation accounted for by G.

Finally, the combination of general intelligence and more specialized group factors still is not sufficient to fully explain the variation in performance between different individuals. There remain specific abilities needed to do well on each test that are not fully shared with other tests.

To account for any individual's abilities we need to know: How capable is he or she in general (G)? What are the strengths and weaknesses on the group factors extracted from the battery of tests? Lastly, are there any particular tests in which the person excels relative to more average performance

Evidence indicates that there is a modest correlation between brain size and psychometric intelligence. The largest data set is based on magnetic resonance imaging of the brains of about 100 individuals who also completed a standard battery of tests. The correlation between brain size and performance on the tests was about 0.3 to 0.4. More detailed questions about whether different regions (for example, the prefrontal cortex) contribute more or less to this association yielded inconclusive results. The modest effect of brain size raises a deeper question: what aspect of brain function -- linked to the size of the neocortex -- affects intelligence? There is only speculation as to the answer.

Simple reaction time is weakly correlated with performance on intelligence tests. Can you indicate whether the correlation should be a *positive* or *negative* number?

How ‘simple’ is Simple RT.

William James

A foregoing *mental condition* is, it is true, a prerequisite for this reflex action.

The preparation of the attention and volition; the expectation of the signal and the readiness of the hand to move, the instant it shall come; the nervous tension in which the subject waits, are all conditions of the formation in him for the time being of a new path or arc of reflex discharge.

The tract from the sense-organ which receives the stimulus, into the motor centre which discharges the reaction, is already tingling with premonitory innervation, is raised to such a pitch of heightened irritability by the expectant attention, that the signal is instantaneously sufficient to cause the overflow.

No other tract of the nervous system is, at the moment, in this hair-trigger condition.

From: Intelligence, A very short introduction (Ian J. Deary)

Intelligence: Nature or Nurture?

Identical -- monozygotic -- twins have *exactly the same* genes.

Fraternal -- dizygotic -- twins are no more genetically similar than siblings. On the average, 50% of their genes are in common.

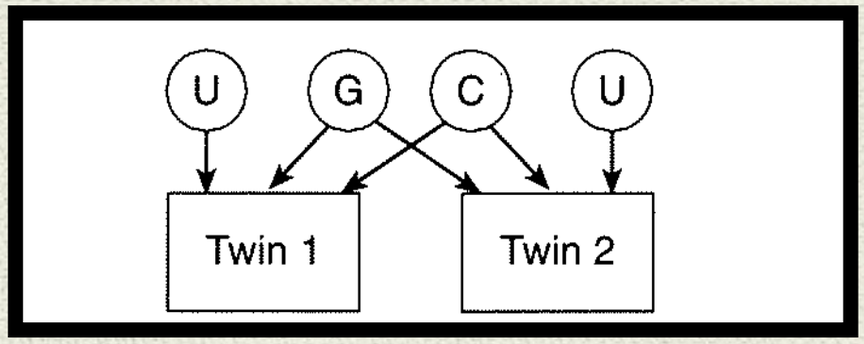
G=genes

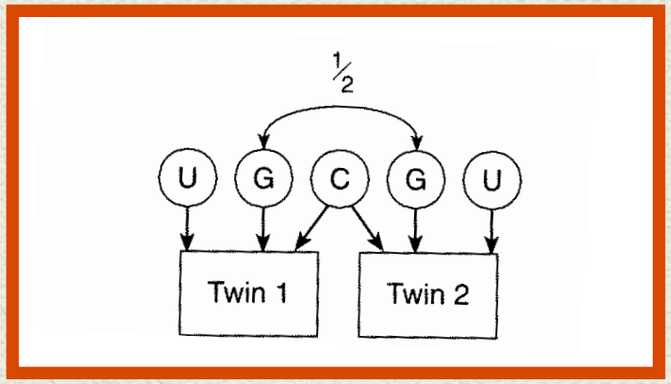
C= common (shared) environment

in the literature, this is also called the 'between family environment' (diet, books in the home, parental attitudes and so on).

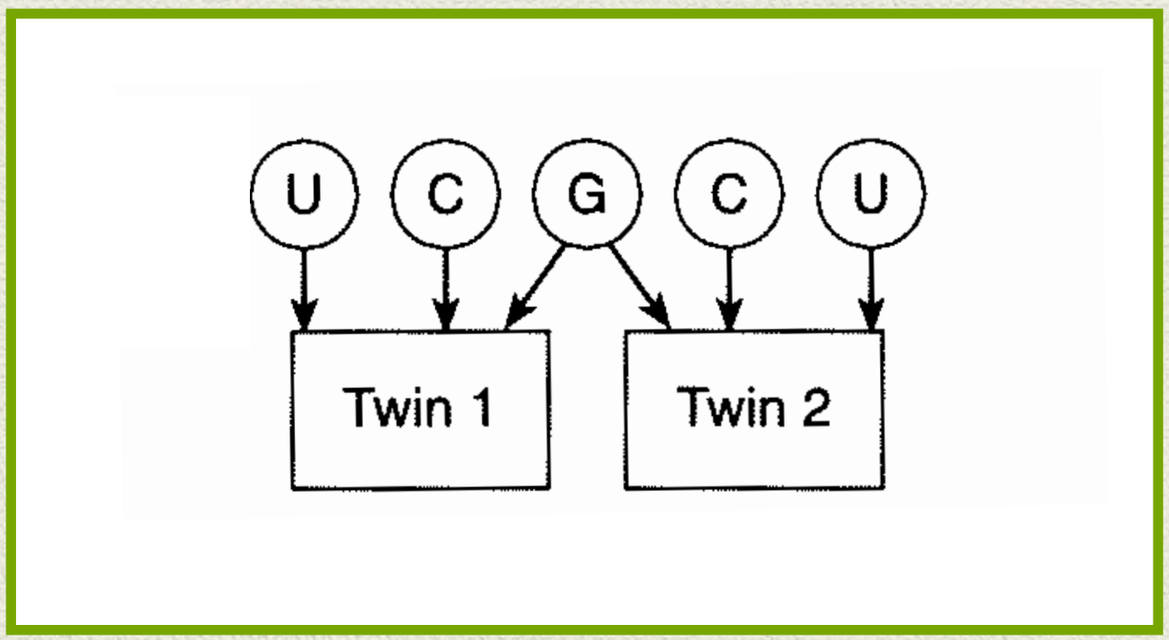
U=unique environment

in the literature, this is also called the 'within family environment' (different hobbies, different friends, and even experience the same events differently).

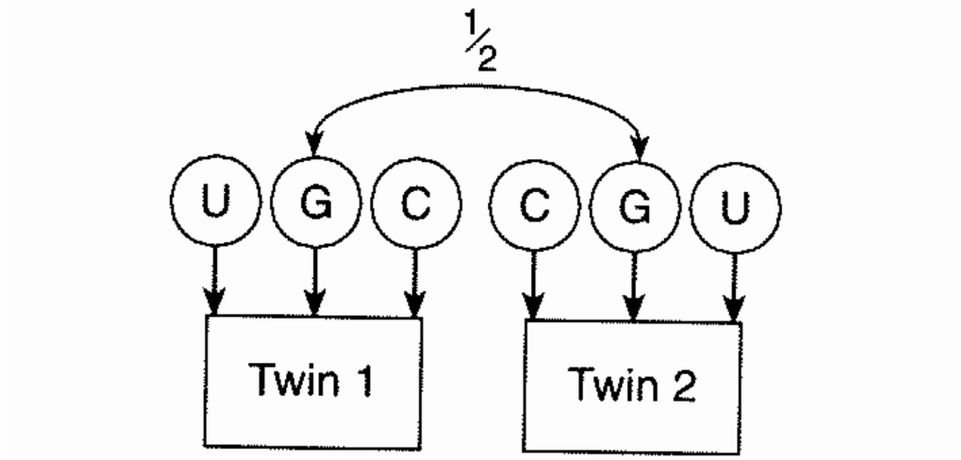




Identical twins raised apart



Non-identical twins reared apart



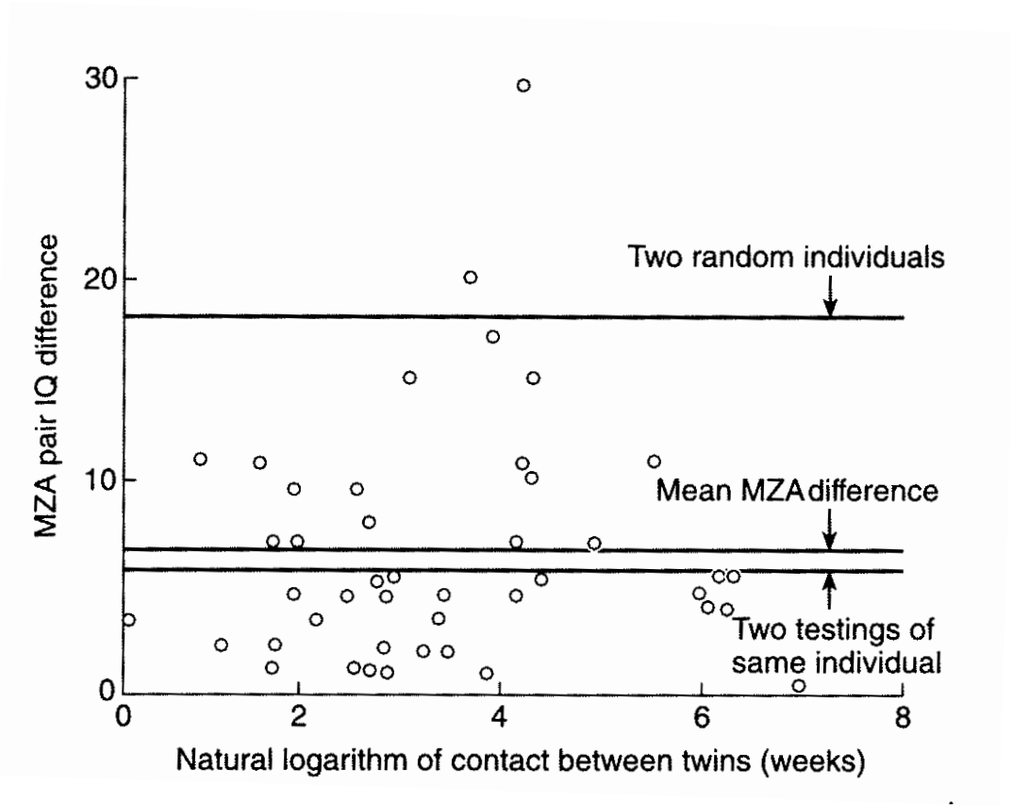
The Minnesota Study of Twins Reared Apart

Identical Twin Scores on the WAIS raised apart: correlation is 0.69

Identical Twin Scores on the WAIS *reared together* is 0.88

‘Twins raised together’ versus ‘Twins raised apart’:

The correlation between the IQ scores of twins differs little when they are raised together and when they are raised apart.


30
20
10
0
MZA pair IQ difference
Two random individuals
Mean MZA difference
Two testings of same individual
0
2
4
6
8
Natural logarithm of contact between twins (weeks)

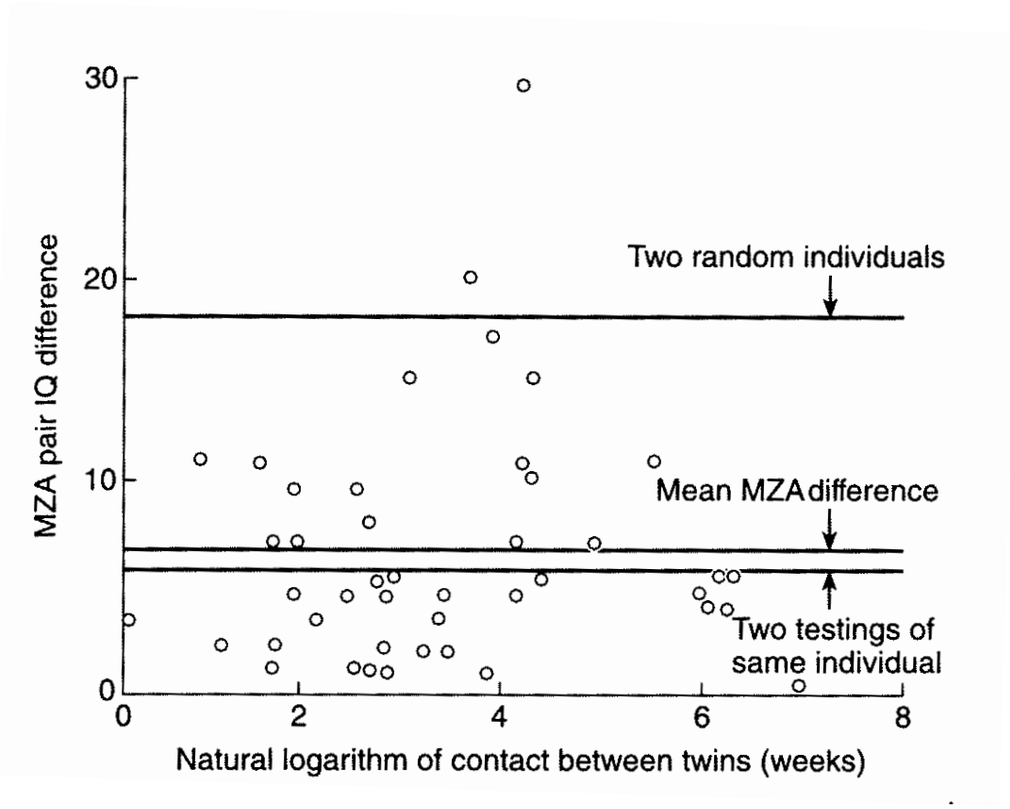
Possible non-genetic reasons for similarity.

1) Intrauterine environment.
2) Members of each twin pair raised apart might have been placed in very similar home environments.
3) Some twins spent time together before being separated.

The Study tried to estimate the effect of the latter two possibilities (for example, estimating the effect of social class on IQ). The evidence suggests that the effect of similar family environment had only minor effects.

Other reasons for the high correlation between the IQ of identical twins raised apart.

1) The twins spent time together in their mother's womb.
2) Members of each twin were placed in similar homes even though they were raised apart. **
3) Some twins were separated only after some time together living together in a common environment. **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Natural logarithm of contact between twins (weeks)

The Minnesota study concluded that genes contribute about 70% to variation in IQ.

What this does *not* mean: The statement does not mean that 70% of your or my IQ score is genetically determined.

What the statement *does* mean:

70% of the differences in IQ scores across a range of individual abilities is determined by genetic factors.

The estimates from different studies vary considerably.

The lowest estimate (from one study) is 30%.

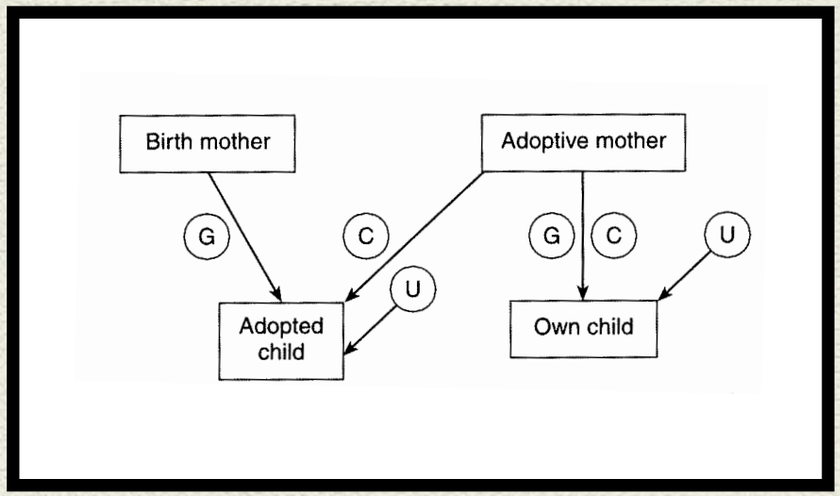
The highest is around 80%.

Does the magnitude of the *genetic* influence change over the course of an individuals' lifespan?

Which has a bigger *environmental* influence:
The family or an individual's unique environment?

How does our upbringing affect our IQ scores?

'Birth mother' gives up her child for adoption.
Baby adopted into another family who have their own child.
We compare the child's IQ with the birth mother's and with the adoptive mother.

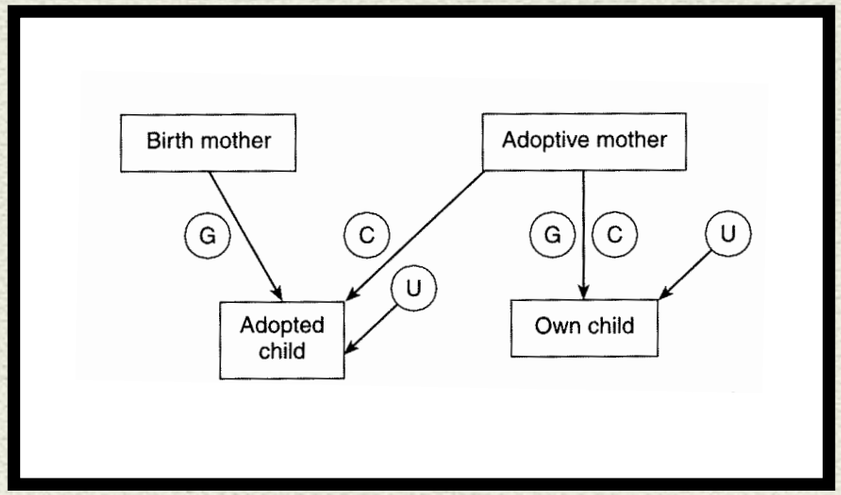


How does our upbringing affect our IQ scores?

Will the IQ of the adopted child resemble the adoptive mother or the birth mother's?

Will the step-siblings' resemble one another in their IQ scores?

Texas Adoption Project



Correlation of IQ between adoptive parents and adopted children was about 0.1.

Correlation of IQ between adoptive parents and their own children was about 0.2.

Correlation of IQ between birth mother and her own child was about 0.3.

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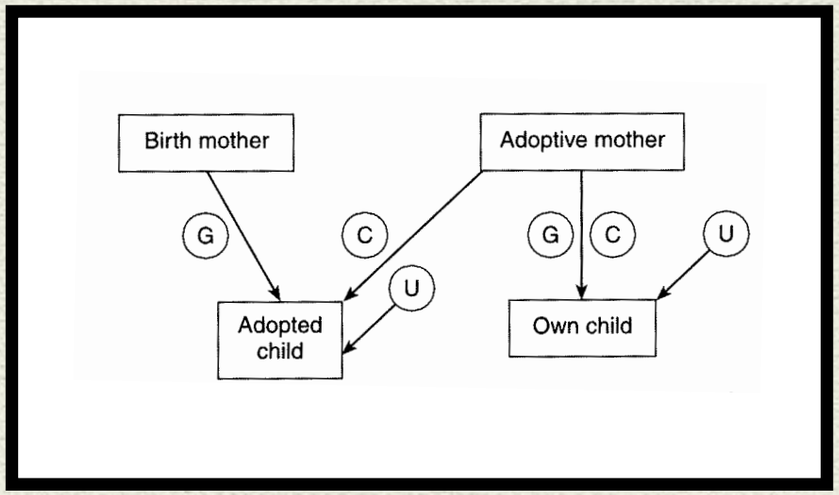


The IQ of biologically related children in the same family correlated 0.3.

The IQ of biologically unrelated children in the same family show a correlation of 0.0.

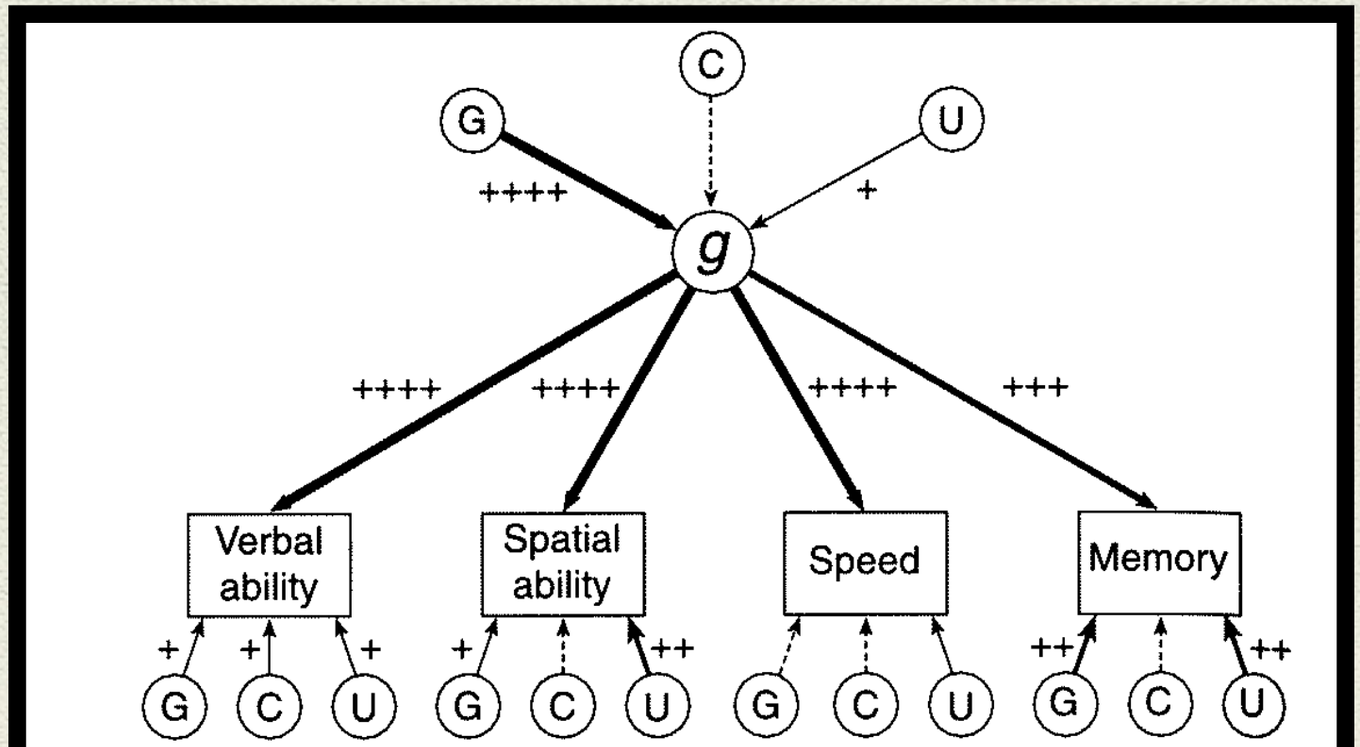
The results of the Texas Adoption project show that the family environment has very little or almost no effect on IQ.

Yet other evidence *does* indicate that our environment has a substantial impact on IQ.

So.....

The evidence suggests that the effect of environment on IQ is not based on C (common or shared family environment) but on U (unshared environment).

The OctoTwin project in Sweden. Identical and Non-identical twins that have taken many IQ tests and are all over 80 years old.



23. The results from the OctoTwin study, which show that differences in group factors of intelligence are heavily influenced by the genetic contribution to general intelligence.