UNLOCKING
CONSCIOUSNESS

BRIAN MIND FORUM

Appendix 026

Measuring Intelligence: History and examples of IQ tests

Commentary on IQ, CAT and isometric tests.

Tests and Measurement

The twentieth century was bedevilled by the controversial 'Intelligence Quotient', or IQ test. For good or ill, together with its variants and derivatives, it is the only intellectual test we have, as opposed to information acquisition examinations. Unfortunately, it became a political football careering between education and social engineering. Its chequered history is well known, but less appreciated is that it was designed *not* to be, and still is not an absolute measure of the intellectual ability we choose to measure, but only a relative value to people of the same age. The value 100 is merely the value of the average individual. It is also only the value of the average of the peerhood of the same age. Thus, three young people whose actual number of correct answers is the same but whose ages are say eight, ten and twelve, would be considered to be very bright, average and backward, yet everyone agrees that children mature at very different speeds. They could quite easily be equal. A recent longitudinal survey of eighty year olds based upon their IQ test results taken in the 1930s in Scotland showed that people with above average IQs had higher salaries and also better health records and lived longer. Cause or effect?

IQ test

For most of the century the community has shied away from studying intelligence. This may possibly be because people who are likely to study the subject professionally may be concerned by what they discover. Stimulated by the drive to design systems that exhibit the attributes of 'artificial' or 'machine' intelligence, it seems logical, one might even say 'intelligent' to try and work out what it is.

The whole drive of this book is to argue that 'intelligence' is essentially the 'autonomic' underlying background operating system of the whole body, executed by the signalling system of the central nervous system, co-ordinated by the brain mind. There is a direct comparison to the 'operating systems in computers, which, likewise, carry out no application, but facilitate carrying out every single one.

We can draw the conclusion that it is not possible to measure an operating system, electronic or biological, but we can measure intelligence *indirectly* by observing the performance of a variety of applications.

In chapter four we have identified a variety of types of intelligence. More accurately we have identified clusters of applications that use the facilities of different facets of the one master operating system. Thus, the application moderated by the operating system delivers the attribute. That attribute, or that cluster of attributes we have traditionally measured to try and establish a means of evaluating intelligence.

These much-maligned IQ test and their derivatives, do measure some aspects of the intelligence we are beginning to define. Fist, speed is of the essence. How many questions can be answered correctly *within a fixed time frame*? Quantity is king. Questions, reflecting their underlying clusters of applications, come in groups so evaluating which type of question is important. This leaves plenty of scope to learn to raise the score at these tests by studying previous exam papers to identify question types more quickly.

Many questions involve pattern matching. *Implications:* which pattern or number or statement is the odd man out? *Extrapolation*: what is the next pattern, number or statement in this series?

Following a logical sequence of events or statements has a worthy place. Not included are many social, or personality attributes, like leadership, resilience, drive, ambition. IQ attempts to measure only a very narrow band of the rainbow of the abilities, aptitudes, skills and talents of the human race. This is probably because, historically, whoever studied intelligence was restricted to thinking about intellectual intelligence, because that was the sum of their backgrounds.

We can also learn a lot from our experience of the ubiquitous Intelligence Quotient or IQ test. For just over 100 years the 'Intelligence Quotient' or IQ test, and subsequently its derivatives, have been the only means of measuring any aspect of innate human 'intellectual' ability. Designed originally by Alfred Binet as a way of identifying pupils falling behind in their studies it was modified at Stanford University –hence the Stanford Binet test – to speed the appraisal of young men into the Army of the United States in 1916. Later, refined versions were developed – the best known being Cattell's Culture Fair Intelligence Test. The IQ test promoted by Cyril Burt was purloined by politicians as a test to select students to benefit from scarce educational resources. The 1944 Education Act designated the IQ test as the means to select eleven-year olds for the very limited number of grammar school places the state thought it could afford to provide. These 'Grammar Schools' proved to be very successful in providing state competition for the private 'public' schools, and a ladder for many able people from the wrong side of the tracks to ascend to the highest jobs in the land. This began to change the social structure of the community and was quickly discontinued by the governments of the sixties and seventies.

[As a political note, Grammar schools began to be discontinued in the 1960' by a labour minister – Anthony Crossland, who had been educated at the prestigious Highgate School, free on a scholarship. The policy was energetically completed in the 1970s by a conservative minister – Margaret Thatcher, who had been educated at Grantham Grammar School at the expense of the State. One excuse was that Cyril Burt had been found to have produced inaccurate research figures to support the decision to use IQ tests. The result was that the social engineers and educationalists diverged sharply. The government forced 80% of young people into 'comprehensive schools'. Instead of improving the selection process, all forms of selection (except on religious grounds) was outlawed. Many famous Grammar schools; many

the pride of their local communities, endowed and founded by local worthies over the previous five centuries had to decide which way to go. The removal of a free alternative reinvigorated the 'public schools'. The full weight of the wealth of the top 10% of the community was poured into the public schools. 'Free' state education had to compete for scarce resources from the Treasury – by the early 1990s many comprehensive school roofs were leaking, and they had to sell off their playing fields. In the 2010s there is much social disquiet that most top positions in every field of activity are filled by the public school's alumni. 20% of young people get, arguably, the best education available on the planet. Some 20% of the population are said to be illiterate. [Not entirely the fault of the IQ test.]

Into this political and social maelstrom arrived the electronic digital computer. For a long time, its significance was not fully appreciated. Maybe this is still true. In the 18th and 19th centuries the invention of the steam engine and then electrical power transformed society as it supplemented human muscles. The puniest of men could pull a few small levers and move a massive load with precision. Other skills became significant. The community struggled to respond to the industrial revolution. Eventually, one response was the 1870 education act. Brains began to replace muscles as the most desirable of human attributes.

Computers supplement human brains. A person of average ability can direct the approach of many aeroplanes to a busy airport by pressing a few keys. Computers are beginning to drive cars. We are on the cusp of having the entire body of human knowledge, art, culture, commerce, teaching and instruction instantly available on our wearable computers. The community is struggling to respond to the computing revolution. Creativity is challenging intelligence. One problem of this new revolution is that neither the IQ nor the CAT and isometric tests derived from it, are able either to measure or identify aptitude or talent for creativity, entrepreneurship or leadership: three of the most needed abilities of the new century.

Answering the questions in these tests can usually be divided into two halves. 1) Working out *how* to solve the problem and 2) executing the chosen algorithm. For instance, some tests are 'odd man out' pattern problems, which come in many types; some magic number square problems, some are progressions, some are logic problems, some unscrambling problems, others are folding paper – spatial, or orientation problems. The more tests people take the more problem types and solution algorithms they become familiar with. From this point of view these tests are partly only tests of the memory of experiences of how to solve them. Scoring higher marks in these types of test can be taught and learned, which rather destroys their raison d'être.

Questions in group 1 are tests of thinking – working out the problem. Questions in group 2 are questions of working through recognisable or learned problems. The two are inextricably mixed up together.

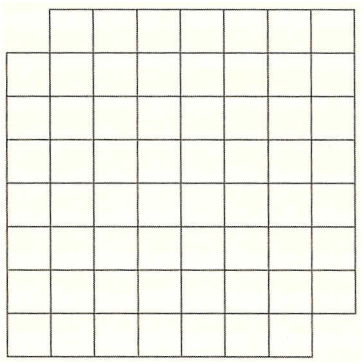
There is another helpful observation we can make about IQ and all other tests. Most questions are about artificial problems, not relevant to most everyday experience. They are abstract. Thus they appeal to people who like intellectual games. Nothing wrong with that. However, it obeys the definition of all tests and examinations; namely that '*All tests select people who are similar to the people who devise the tests'*. IQ tests undoubtedly measure certain, if limited attributes, but they also reinforce the status quo, to the immense disadvantage of the majority of the population who have a myriad of other skills in the rainbow of human abilities.

Case Study 1

One of the most famous examples of symbolic logic, the study of insight problems, and the basis of many examples of intelligence test questions was designed by Craig Kaplan and

Herbert Simon one of the original creators of the General Problem Solving (GPS) computer program and a founding father of Artificial Intelligence.

Imagine that you are given a board divided into sixty-four (eight by-eight) small squares. The top left and the bottom right squares have been removed. You also have thirty-one dominoes, each big enough to cover two squares. Either show how the dominoes can be arranged to cover the remaining sixty-two squares, or prove that this cannot be done.



Kaplan and Simon insight problem.

The conventional answer, accepted by this whole specialist community, says that it *cannot* be done. But this is not a complete answer, and the argument high lights some interesting points. The whole argument depends on the word 'domino'. In the first place, if a student comes from a community that has never heard of 'dominos' then the whole question is meaningless: thus making the point that IQ tests have a high content of cultural input: and is not just about innate intelligence.

Secondly, the answer depends of the specification of a 'domino'. Most people presume a domino is rectangular. But why? Why not a figure of eight domino? If you accept a figure of eight then the answer to the famous Kaplan Simon insight problem is that it *can* be done!

And the proof is simple: reduce the image to four squares and remove the top left and the bottom right squares. It is immediately obvious that a rectangular domino *cannot* cover the remaining two squares, and a figure of eight domino *can*.

Why has the 'accepted wisdom' answer been adopted universally without question? The answer is revealing. Anyone who knows about dominos has in their memory an image of a rectangle. In their brain there is no neural structure of any other shape. If there is no alternative neural structure, no alternative 'comes to mind', so everyone has ignored the shape of the domino and has concentrated in trying to manoeuvre imaginary dominos around the remaining 62 squares with frustrating lack of success.

This example teaches us that if there is no neural structure in our brain representing some thing or image, we cannot think about that thing or image. Useful lesson.

We have a lot more to learn about intelligence, both neural and 'artificial'!

Case Study 2.

In his ground breaking new book '*Intelligence in the Flesh'* Guy Claxton makes the point that "*being able to figure out the next number in the sequence 1 2 3 5 8 is a very poor proxy for your ability to act wisely when you lose your wallet."*

We can learn something else. If you recognise these 'Fibonacci numbers', you know the answer is 13.

If you have not come across them you could puzzle away 2-1=1, 3-2 =1, 5-3 =2, 8-5=3, 1-1=0, 3-2=1, so 2=2. Give up? There is a minute gone. So IQ scores depend on cultural knowledge, not just intelligence.

Case Study 3

Follow a logical argument

The ability to hold a number of concepts in the forefront of our minds is another aspect of both intelligence and the ability to think and be creative. There is a famous old chestnut that regularly appears in IQ and derivative tests:-

A man stands looking at a picture and says "Brothers and sisters have I none, but that man's father is my father's son". Who is he looking at? It is very easy for the various statements to interfere with each other, oddly and especially because of the rhymes and repetitions. The solution is to carefully keep separate the statements, and answer one question at a time. It also helps to imagine looking at the picture of a man. Solve the last question first. 'My father's son is me'. So, if that man's father (in the picture) is me I must be looking at my son. The side issues are interesting. The 'brothers and sisters have I none' phrase obviously excludes 'my father's son being a brother, but it also muddies the waters. It can help in understanding the role of rhyme, rhythm and repetition in memory formation and meaning. Multi-media is always helpful in learning, recall and processing.

Case Study 4

When we learn to ride a bicycle, we teach our brain to adjust the handlebars to turn in the direction we begin to feel we might fall off. We grow the neural circuits to do this quite automatically – in autopilot- under the control of our 'background autonomic operating system'.

If someone invites us to ride a trick cycle that has been engineered to turn the opposite way to how we move the handlebars, we will fall off immediately. Even when we know of the change we fall off. With practice, we can teach ourselves to ride the trick cycle. If we revert to a normal cycle, we fall off again!

Case Study 5

In his book, *Intuition Pumps and other Tools for Thinking* (Allen Lane, 2014) Professor Dennett included a chapter (24) which shows, with wonderful clarity, how a box of integrated circuits can be programmed to beat a chess master and thereby uses our knowledge of computing to help demystify the apparent complexities of the brain. It is probably the best description of the fundamental architecture of software ever written. A reprint of this chapter is available through Amazon, either for Kindle or as 'print on demand' hardcopy*. 'Convergence', by Daniel Dennett, published by the Brain Mind Forum.* It is also reproduced at appendix 32.

Case Study 6

Computers do not hold numbers in their processors and memories. They hold binary patterns that represent numbers. They represent negative numbers by a value pattern preceded by a 'negative' marker. In early computers it was possible to have both a positive and a negative zero. Normally, say, the payment of a bill in full, involved a positive value minus a negative value giving a positive zero. Account closed. But if the calculation started with a negative

value to which was subtracted a positive value the balance was a negative zero. Early programs looked for accounts which had a negative marker to the balance and issued demands for payment. Thus, people received demands to pay £zero in seven days on pain of prosecution. Entirely logical to a computer programmer!

Note: The history of computing is endlessly entertaining!

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