The Neuroscience of Intelligence

Richard Haier

Measurements of the brain corroborate IQ tests and genomics

Intelligence research traditionally focused on intelligence testing. It was one of the two fields on which the science of statistics was founded. Statistics analyzes correlations among variables. What Charles Spearman found 100 years ago was that children who did well on tests of mathematical ability tended to do well on English, French, even musical ability. He posited that there was an underlying intelligence factor. He called it g, the general factor of intelligence, which related all measures of school ability.

Haier relates that history and agrees with it. However, this traditional psychometric approach ran into two difficulties about 50 years ago. First difficulty was that by 50 years ago they are had invented most of the optimal ways to operationalize the measurement of intelligence to put on pencil and paper tests . The second difficulty was that political liberals, for reasons of conscience having nothing to do with science, dismissed the whole thing. The whole field of intelligence research fell into bad odor. People would deny the reality of intelligence, claiming that the tests were biased, even that there was no such thing as intelligence – it was a meaningless idea.

Haier describes the science susequent to traditional psychometrics, following it in two directions. The first is genomics. Scientists have long known that intelligence was 80% heritable. That in itself should have been a refutation of the deniers, but they refused to accept the evidence. Genomic researchers are finding more and more specific alleles, genes, that seem to be related to intelligence. The frustrating thing is that there are thousands of them, and no individual gene seems to account for as even a significant fraction of 1% of intelligence. Nonetheless, that from that genomic side, they have pretty good theories as to how and how intelligence is passed on from parent to child.

The other area of research, Haier's, has to do with measuring what's going on in the brain. The tools to measure activity in the brain have become increasingly sophisticated over the past 30 years. The first one, pet scans, or proton emission tomography, required injecting radioactive substance into the brain. There, the radioactive substance with could then be what then are generate gamma rays that could be captured on a x-ray film in which show more or less where the harm injected material was traveling around in the brain. But primitive, but better than nothing. Next came MRIs, static MRIs, they gave a pretty good picture of the brain. He could get a good image of where that dark and the light matter was, and their theories as to how intelligence is related to that white matter in the gray matter. Next came functional MRIs, a big step forward, in which researchers were able not just to take a static picture of a brain, but to watch as the brain lit up in a pattern as people as subjects undertook the tasks they were given. So you could ask research subjects to do demanding or not demanding our mental exercises and watch what parts of the brain lit up as they did them. This has progressed further with increasingly sophisticated techniques such as the magneto-encephalogram (MEG), able to access regions of neuron activity dynamically every millisecond during the performance of a cognitive task.

Brain imaging has revealed some interesting differences among people. When given a cognitive problem, people with high measured intelligence show brain activity in different parts of the brain than average people. When men and women of equal measured ability are given the same cognitive problem, the two sexes seem to use different parts of their brains to solve them.

So that's the overall story. People want to deny the reality of intelligence are now faced with the task of denying the reality of physical of the imaging of brains, I should mention. Also, the reaction time tests

that have been being done for a century or more, and they are faced with the reality of it. Denying the genomics that suggest how intelligence is is compiled. In other words, they have to be. They have to be willfully blind in order not to see that intelligence is highly heritable.

With regard to the argument as to whether intelligence is relevant, intelligence has always been highly correlated with measures of real-world success – academic achievement, workplace achievement, and income just to name three. These are so obvious that as to be undeniable unless you're a real zealot and work very hard not to believe it.

Haier expresses the concept that I have long known intuitively but didn't have words for. Intelligence is not measured on a ratio scale. That's important. Our weight and height are measured on a ratio scale. As to say that there something can weigh 0 pounds or can be a 0 inches tall. There is no zero on the intelligence scale. Intelligence measures relative performance among people. The standard is an IQ of 100, the average for a population. That average does not stay still. It is not average is not constant across time, and is certainly not constant across populations. It's a moving target. One of the things that Haier hopes to do is to establish a ratio scale for measuring intelligence.

I'll note that that offers that is not a total solution, although it will be a big plus. Haier measured it in a question of brain speed. They can measure that. So he can say that the clock speed of the brain help fast is a subject able to answer questions.

However, a lot of intelligence testing is a matter of can you solve the problem or not. Typical examples would be: can you multiply the given to two digit numbers together in your head and come up with the right answer? Some people can, some people simply cannot. Ever. The same goes for verbal intelligence. If a test asks, "what's the relationship between a regatta and a fleet?" or "What's the relationship between a regatta and a peleton?" some people who will never be able to answer the question. They simply don't know the words, or if they know them. They simply can't make the facilities syllogisms. So a lot of intelligence is not ratio scale. It is binary. Can they answer the question or not?

An intelligence test measures how many questions a subject is able to answer, but still not on a ratio scale. There is no assurance that the questions are commensurate, that they do the same thing. Psychometricians try very hard to make test items commensurate, to ensure that they measure the same thing, but each question is really a separate entity. It will never be possible to say that Dick is 50% smarter than John. Or 150. In fact, in areas where it might be measured, there will be some metrics by which somebody may be a thousand times smarter than somebody else. John Van Neumann would be a thousand times better than me at the multiplying together five digit numbers in his head. I might achieve one pair of numbers after many hours of laborious work. He could do an instant. The ratio scale doesn't make sense for this. It's binary. He could do it. I can't. It is absolutely certain that brain scans would show totally different areas of his brain being active working the problem that would be for my brain.

As a companion to Haier's book, I recommend Richard Plomin's recent book "Blueprint." Plomin has been investigating the connection between genomics and intelligence, with little reference to measurement systems. The two books together provide a good understanding of the state-of-the-art in intelligence research.