Reawakening the Creative Mind

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Ever since the first bright spark invented fire, the recipe for genius has been one of culture's most alluring quests. And yet, historically, our conception of genius has been surrounded by a de facto mystery. The idea that it could be explained would, under certain conceptions, appear to run counter to its essence. In Roman times a genius was as an innate god given trait at birth. But with the dwindling of the Gods who, from antiquity through to the enlightenment and beyond, had been the notional source of creativity, it has fallen to others to do the explaining. Even modern science has been somewhat reluctant in taking up the challenge of exploring the nature of creative genius. The Gods have been replaced by unpredictability; genius seems to elude any singular systemic explanation. Part of the problem for science has been attempting to distil a working definition that removes the more subjective and untestable historical and cultural associations of genius while still retaining our idea of it. This is far from easy. One tenet of the term is that a genius must be recognised as such by the relevant experts in the field. By that reckoning if Albert Einstein had never published his theories he would have been barred from the title. Despite the many difficulties with investigation (hence the mixed results) scientists have tried to unpack genius into components as various as intelligence, structure and function of the brain, madness, levels of disinhibition, even our genetic inheritance.

Just after the First World War ended psychologist Lewis Terman tried to find out the developmental mainspring of genius. Are you born with it? If you've got it do you have to look after it? Does it guarantee deathless glory or can having it spell catastrophe down the line – 'Early ripe, early rotten?' as the saying used to go. He selected a group of boys and girls with high intellectual potential (IQ scores from 135 to 200) and for the next 70 years Terman followed and recorded everything about them, from their preference for certain types of food through to their professional status – the results run to six volumes. Perhaps surprisingly these kids – who, after their discoverer, came to be known as The Termites - did not turn out to be the scrawny geeks that we might expect and hope for. Rather they bore many of the hallmarks of a master-race; they were taller, physically healthier, more economically and socially successful than their averagely endowed counterparts. And yet, to Terman's dismay, not one Termite emerged as a creative genius. Only one, a certain Robert Oppenheimer, generated any enduring cultural artefacts, and that was the US TV sitcom – 'I Love Lucy' – and few would argue for that show's immortal sublimity. So if IQ doesn't underpin our creativity – what does? And in the terms of neuroscience, what role might the maturation of the brain play in laying the foundations for genius.

Brain development is on a hectic timetable given that several trillion synaptic connections must be laid down for the brain to function at average levels. During early pregnancy brain cells are fashioned at 250,000 per minute, and this continues at a ferocious rate for the first few years of infancy: connections form that allow you to crawl, walk, then talk. There are recognised critical periods when we must use our brain or risk loosing faculties such as language. The process of constant organisation and reorganisation continues until early adult life and some say beyond. During adolescence the brain 'prunes' millions of the now redundant branches it had established. The pruning is a process of adapting the organ to its environment therefore accomplishes, somewhat counter-intuitively, an increase in our cognitive capacity. Interestingly a colleague of mine, Prof David Skuse, has highlighted a dip in teenagers' social intelligence and speculated that this was probably because their brains were being rewired at that time. The timetabling of our cognitive development would seem to preclude childhood genius and yet our experience suggest otherwise.

Einstein was 16 years old when he wrote his first scientific paper on the subject of magnetism and the aether. 10 years later in 1905 he had a moment of revelation while riding in a street car looking back over his shoulder at a receding clock tower, "A storm broke loose in my mind…the solution came to me suddenly with the thought that our concepts and laws of space and time can only claim validity insofar as they stand in a clear relation to our experiences..". He had, in one leap of genius, arrived at the Special Theory of Relativity – in essence, the faster you move, the slower time goes. Over the next 6 weeks he exhausted himself scribbling down the mathematical details which looked to all intents and purposes like so many hieroglyphs, beautiful perhaps, but nonsensical. Yet these 31 handwritten pages would change the course of our history. What was so different about this young man?

Last year I interviewed neuroscientist Prof Marion Diamond, from the University of Californian, for a TV programme investigating the nature of Einstein's genius. She smiled as she explained, "They arrive floating in a Kraft mayonnaise jar". She was referring to pieces of Einstein's brain that had been sent to her by Dr Thomas Harvey, the pathologist who neglected to put the brain back in the body at autopsy. She went on to explain that when she sliced and stained Einstein's brain she found it had more glial cells (cells that provide physical and nutritional support for neurons) in one particular part of the brain. But why more glial cells? It's probably because Einstein effectively 'worked-out' part of his brain doing hours of calculations and in so doing brought about a reorganisation of certain connections that led to the enhancement of his maths ability.

But beyond intense mental exercise it is likely that Einstein's brain was innately endowed with the potential for extraordinary performance. In the 1990's Dr Sandra Wittleson analysed the external surfaces of Einstein's brain and the results were published in the *Lancet*. The overall brain size was unremarkable, but on both sides just above where the ears would be, there was an unusual pattern of grooves and ridges found in the same area that Diamond had encountered the excess of glial cells with the region of changes in glial cells. The external structure of the brain is dictated early on in development. It may be that the idiosyncratic fusion of specific regions of the brain could have given him an advantage in taking on board certain types of information.

At the time of Einstein's death the function of these brain regions were unknown. A few years ago a colleague of mine, Dr Elizabeth Isaacs, who was investigating children with problems in mathematical calculation at school, found that the children had less brain matter in the left parietal lobe, the same area where structural abnormalities had been observed in Einstein's brain. Therefore, it would appear that part of the brain has been hardwired for maths calculations. Not that you have a 2x2 table in your head, but that you have a predisposition to take on board mathematical nature, as it's proved over millennia to be advantageous to our problem-solving abilities and hence our survival.

My bet is that Einstein was born hardwired for maths, and when placed in the right environment, his brain reorganised and flourished, to allow his is ideas to be realised. But just having a good maths area does not allow you to have those moments of revelation, those insights that occur in a flash. Even Einstein admitted as much "When I examine myself and my methods of thought, I come to the conclusion that the gift of fantasy has meant more to me than any talent for abstract, positive thinking."

In 1959 Lubow and Moore introduced the concept of latent inhibition: the ability we all have to filter out irrelevant stimuli. Thus we can read a book, walk down the street and hold a conversation, or go to sleep in a noisy room. Yet this ability may hold back our creativity. It appears that creative people are prone to be flooded with irrelevant thoughts and ideas, as they are less able to filter them out, as such this permits more creative associations to be made. This ability to free yourself from more consciously regulated activity, using a more disorganised or disinhibited way of thinking, may underpin those moments of clarity. Is this why Samuel Taylor Coleridge could only see Xanadu in a dream, in the same way as Nobel prize winner Otto Loewi saw nerves impulses and Fredrich Kekule saw the benzene ring. These accounts suggest that unconscious processes are at work and as Gertrude Stein has emphasised they cannot be summoned at will 'It takes a lot of time to be a genius, you have to sit around so much doing nothing, really doing nothing'. Therefore lowering your filtering threshold to allow the mind to wander may permit information to pour in an oblique way, facilitating the making of extraordinary associations.

In neuroanatomical terms, it is the frontal lobes of the brain that control many of our higher cognitive functions; our social behaviours, our abstract thoughts process, our novel ideas and planning. The frontal lobes are not fully developed until the early 20's, and perhaps only then permit the creative mind to link up fully with all our experience that is now imprinted on our organised brain. A few years ago I came across a patient who had never done any artwork in his life until, following a stroke, which occurred in the frontal area of his brain, he suddenly felt an insatiable need to create paintings, drawings and sculpture. He now finds it difficult to inhibit irrelevant thoughts coming into his mind, yet it is precisely the novel associations that these thoughts engender that seem to provide the bases for his creativity. It may be that the stroke has caused a *disinhibition* of brain pathways allowing his newfound creativity to surface. Studies by Prof Allen Synder have suggested that if you 'knock out' parts of the frontal lobes in normal volunteers you can improve their creativity. Perhaps, whatever was keeping his artistic talents hidden or dormant has been damaged just enough to allow them to emerge. Somewhere, it seems, a floodgate has been opened.

Perhaps a distinction must be made between the child genius and the mature creative genius. The former tend to have an early recognition for one task, and reminds us of what is possible with early sustained practice and a predisposition. The creative genius may be focused in one field, yet brings an insightful vision, which may be a product of the disinhibited mind.

Dr Mark Lythgoe will discuss 'What is Genius?' on 30th Sept at the Barbican (The Pit Theatre 6pm)