

THE CREATING BRAIN: THE NEUROSCIENCE OF GENIUS

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Plume Publishers, 2005

- I am an M.D. and a Ph.D. My Ph.D. is not in biochemistry or biology, but instead in Renaissance English literature. The first book that I published was *John Donne: Conservative Revolutionary* (1967).
- The first modern effort to define and study creativity with the systematic tools of modern psychology was conducted by Lewis Terman at Stanford University. Terman began with the assumption that “Genius” and “High intelligence” were the same thing. Starting in 1921, he launched a landmark “study of genius,” which was continued after his death in 1956.
- In common usage in Roman times, genius originally referred to a god or spirit given to each person at birth that would determine his or her character and fortunes. In early English usage this meaning was sometimes retained, as in Sir Philip Sidney’s statement that “a poet, no industry can make, if his own genius be not carried into it.”
- The precocious child was considered to be abnormal, and those who believed that slower maturation led to a better long-term outcome in life followed the slogan, “early ripe, early rotten.” In sort, genius in children was not a good thing.
- UCLA was originally Los Angeles Normal School
- Louis Terman was the first to measure intelligence. In 1916, he published *The Measurement of Intelligence*. A modest man, Terman named the test after the contributions of his Stanford students as well as Binet who created simple tests of memory and reasoning. Binet was the first to develop a measure that took into account a child’s knowledge changes and increases with age.
- The Terman study of genius provided the first clear scientific evidence that genius (in the sense of creativity) was not the same as a high level of intelligence. In fact, William Shockley and Luis Alvarez, both born in California during the time frame within which Terman’s geniuses were recruited, did not make the cut – but they did become Nobel laureates in physics.
- A domain is an area of knowledge, such as mathematics, that forms a component of what we refer to as culture. The field consists of people who are gatekeepers to the domain. The field is comprised of critics, collectors, museum curators, journal reviewers or funding agencies. As for the role of the person, Csikszentmihalyi states: Creativity occurs when a person, using the systems of a given domain such as music, engineering, business, or mathematics has a new idea or sees a new pattern, and when this novelty is selected by the appropriate field for inclusion into the relevant domain.
- One essential component of creativity is originality. Creativity involves perceiving new relationships, ways of observing, ways of portraying.
- A second component of creativity is utility, very broadly defined. The concept of utility must be broadly defined, however, because creativity in the arts is not always obviously useful. Its utility resides primarily in its ability to evoke resonant emotions in others, to inspire, or to create a sense of awe at what the human mind/brain can achieve.
- A final component of creativity is that it must lead to a product of some kind. Creativity requires the creation of something.
- Ordinary creativity can be nurtured and enhanced in a variety of ways. Extraordinary creativity, or creativity in its purest form, is my main emphasis in this book, because examining the minds and brains of great geniuses is a fascinating endeavor that teaches us a lot about the creative process.
- The Threshold Theory holds that above a certain threshold, intelligence and creativity are not closely related to one another.
- Personality traits that define the creative individual include openness to experience adventuresomeness, rebelliousness, individualism, sensitivity, playfulness, persistence, curiosity, and simplicity.
- Creative people tend to approach the world in a fresh and original way that is not shaped by preconceptions. The obvious order and rules that are so evident to less creative people, and which give a comfortable structure

to life, often are not perceived by the creative individual, who tends to see things in a different and novel way. This openness to new experience often permits creative people to observe things that others cannot because they do not wear the blinders of conventionality when they look around them. Openness is accompanied by a tolerance for ambiguity. Creative people do not crave the absolutism of a black and white world; they are quite comfortable with shades of gray. In fact, they enjoy living in a world that is filled with unanswered questions and blurry boundaries.

- The lack of evident and obvious standards of perception or information may produce a blurring of the boundaries of identity or self, sometimes referred to in psychodynamic terminology as ego boundaries. This may be one of the traits that explains the higher rate of mental illness in creative people than in the general population.
- Living on the edge of chaos may be psychologically dangerous, because approaching too close may even lead to falling off occasionally into mental disorganization or confusion. This may also partially explain why creative people have higher rates of mental illness.
- Creative people have an ability to persist in spite of repeated rebuffs. Creative people are often perfectionistic and even obsessive. They must work on a topic, project, or idea until they get it right.
- Much of the time, their work is really all that creative people care about.
- The construct of divergent thinking has been criticized based on the view that ideational fluency is not the same as originality. Perhaps the harshest criticism, however, is that these tests may lack predictive validity. The enthusiasm for tests of creativity that focus on divergent thinking has diminished.
- In order to create, many creative people slip into a state of intense concentration and focus. In psychiatric terms, this could be described as a “dissociative state”.
- This capacity to focus intensely, to dissociate, and to realize an apparently remote and transcendent place is one of the hallmarks of the creative process.
- Creativity is not a rational, logical process. The essence of a creative product usually cannot be consciously planned or willed into existence. The notion of the muse, or the need for inspiration, is much more than a metaphor.
- Within the creative individual, the wandering mind is experienced as producing a steady input of ideas that may be somewhat fragmented and formless.
- Creative people tend to be observers. Creative people have the capacity to be disengaged and dispassionate observers. To others they may seem aloof, detached, or even cold-hearted at times. They themselves, they often feel as if they are watching the rest of the world without others even knowing about it.
- Tchaikovsky: Do not believe those who try to persuade you that composition is only a cold exercise of the intellect. The only music capable of loving and touching us is that which flows from the depths of the composer’s soul when he is stirred by inspiration.
- Stephen Spender: Inspiration is the beginning of a poet, and it is also its final goal. It is the first idea which drops into the poet’s mind and it is the final idea which he at last achieves in words. In between this start and this winning post, there is the hard race, the sweat and toil. One line is given to the poet by God or by nature, the rest he has to discover for himself.
- Our brains use glucose as their sole fuel, and they burn an average of 20 percent of the calories we use per day, while constituting much less than 20% of overall body mass.
- The human brain is perhaps the most superb example of a self-organizing system that one can find. It is constantly and spontaneously generating new thoughts, often without any apparent external control. The human brain, with its trillion neurons and quadrillion synapses, has nearly endless components to self-organize.
- It is likely that one factor contributing to literary creativity is having a lexicon not only large in quantity of words, but also rich in associated meanings for each word.
- Freud developed the idea that inexplicable physical complaints might be repressed memories, of which his patients were unaware, but which had collected in the unconscious compartment of their minds and were making physical mischief. He decided that if patients could recall these memories and release them by talking about them, they might relieve the symptoms. But how to get them to recall and release the memories. Perhaps it might happen if they would lie down on a couch think freely and say whatever came

into their minds. This process was called free association because it relied on pulling up a variety of associative links that lurked in the brain at an unconscious level.

- The concept of free association did not begin with Freud. It was created by early association psychologists such as Wilhelm Wundt.
- Free association is the kind of mental process that occurs when a person eliminates motor and sensory input by stretching out on a bed with eyes closed and just thinks. This mental process, which connects apparently unlinked things without conscious effort, is an important resource for creativity.
- Episodic memory is autobiographical memory, the recollection of information that is linked to an individual's personal experiences.
- Random episodic silent thought (REST)
- These introspective accounts describe a process during which thought is not only non-sequential or nonlinear, but during which non-rational unconscious processes play a role. It is as if the multiple association cortices are communicating back and forth, not in order to integrate associations with sensory or motor input, as is often the case, but simply in response to one another. I would hypothesize that during the creative process the brain begins by disorganizing, making links between shadowy forms of objects, symbols, words, or remembered experiences that have not previously been linked. Out of this disorganization, self-organization eventually emerges and takes over in the brain. The result is a completely new and original thing: a mathematical function, a symphony, or a poem.
- Possessors of extraordinary creativity are apparently blessed with brains that are more facile at creating free associations.
- The mentally healthy adopted children of schizophrenic others tended to have a higher rate of creativity than the adopted children of the mentally healthy mothers.
- While less creative people can quickly respond to situations based on what they have been told by people in authority – parents, teachers, pastors, rabbis, or priest, the creative person lives in a more fluid and nebulous world. He or she may have to confront criticism or rejection for being too questioning or too unconventional. Such traits can lead to feelings of depression or social alienation.
- Creative individuals have sometimes complained that they are too easily flooded by stimuli, so that they become easily distracted. Some writers found that they were prone to be too sociable, such that their tendency to seek out other people interfered with getting their work done. They often had to organize their lives so that they were isolated from human contact for long blocks of time. In fact, the tendency of some to drink excessively may have been an effort to use alcohol as a central nervous system depressant to cope with their sensitivity to being flooded by stimuli.
- Aaron Copland: Too much depression will not result in a work of art, because a work of art is an affirmative gesture.
- Two common traits of the creative mind and brain: the need to have free-floating periods of thought during which inspiration may come as the brain spontaneously self-organizes and new associative links are found, and the uncompromising and obsessional perfectionism that seeks to achieve the ideal product or result.
- It is more difficult of the creative brain to prosper in isolation. Solitude is usually necessary, for the actual creative process to lead to a creative product. But the catalytic substrate for that process is often interaction with others and intellectual exchange of ideas. Creative people are likely to be more productive and more original if surrounded by other creative people.
- Although the creative personality tends to be independent and individualistic, creative people are helped by direct nurturance and support.
- Almost all periods of great creativity, populated by many creators, have been times of economic prosperity.
- Five characteristics of cradles of creativity
 1. Critical Mass of Creative People
 2. Competitive Atmosphere that is Free and Fair
 3. Mentors and Patrons
 4. Economic Prosperity
 5. Environment of intellectual freedom, ferment, and excitement

- Whatever the importance of nature, nurture is also important for creativity to flourish, and perhaps essential. The human brain is shaped by the world around it from the time that a child is born to the end of adult life.
- Orchestra musicians do appear to have enhanced their visual/spatial cognitive skills through practice and performance.
- Musical performers have an enlargement of the cerebellum, a part of the brain that is highly developed to monitor motor coordination and is also now recognized as a monitor of rapid online cognitive activities.
- Orchestra musicians also had more gray matter overall than did the non-musicians and their brains were also less susceptible to gray matter loss than were those of the non-musicians.
- Creative people have particular personality and cognitive traits such as openness to experience, curiosity, and a tolerance of ambiguity. We have learned that they often get their ideas as flashes of insight, through moments of inspiration, going into a state at the edge of chaos, where ideas float, soar, collide, and connect. We have learned that this creative state arises from a mind and brain that are rich in associative links that encourage new combination to occur freely. And we have learned that the brain is plastic – that we can change and hopefully improve our brains by exercising them.
- The fact that we can all generate novel speech on the fly is a testament to the extraordinary ordinary creativity of our glorious human brains.
- Participating in a book club or reading group, meeting regularly to discuss reactions to a book's ideas and content, is a creative activity.
- Many of us have exercise programs for our bodies. Very few of us have exercise programs for our minds and brains.
- Creativity may often arise from taking ideas from one field and transferring them to another, and that mastering one field is a good foundation for mastering another.
- A polymath is a person who knows many things and who has mastered many fields.
- Sparks of Genius by Robert and Michelle Root-Bernstein
- As you persist in mental exercises, you may get a thinker's high that is comparable to a runner's high.
- One of the most powerful factors that protects against degenerative brain diseases such as Alzheimer's is higher levels of education.
- Exercises for the brain
 1. Choose a new and unfamiliar area of knowledge and explore it in depth
 2. Spend some time each day practicing meditation or "just thinking"
 3. Practice observing and describing
 4. Practice imagining
 5. Read together, interactively
 6. Emphasize diversity
 7. Ask interesting questions
 8. Go outdoors and look at the natural world
 9. Get interested in music
- The study of the effects of meditation on the brain has become a serious area of research in neuroscience, and it indicates that practicing meditation has measurable beneficial effects on brain function. Recent studies have focused on a brain characteristic known as gamma synchrony. Gamma waves are very high frequency oscillations occur in the brain. When they occur in synchrony in different brain regions, this pattern is thought to reflect the communication of neuronal groups that are widely distributed through the brain and that are engaged in integrating complex information in order to discover its meaning or to solve a problem. Monks have markedly higher levels of gamma synchrony, in fact the highest that have been measured. Apparently, their meditative practices also improved the harmony of their brain function when they were not meditating, because they had higher gamma synchrony than as well.
- Observe carefully. You will probably become better at remembering faces. Your vocabulary will grow. Your writing will improve. And you will be growing new synapses in your visual, language, and association cortices as a consequence of this mental exercise.
- Being active and exploratory (getting into trouble) is how a child learns about the world. Too much TV prevents this. It trains the brain to receive, but not to interact. It trains the body to sit inactively for long

periods of time, decreasing the time available for exercising muscle and learning to coordinate eye-hand movement and large muscle movements.

- We must use our recognition that the brains of geniuses cannot see boundaries between fields such as art and science to implement changes in teaching practices and curricula. Teachers need to learn new ways to show their students how that silos of language arts and biology and mathematics are in fact connected, and connected in very interesting ways.