Medical Hypotheses 74 (2010) 606–612

Contents lists available at ScienceDirect

Medical Hypotheses

journal homepage: www.elsevier.com/locate/mehy

The creative brain – Revisiting concepts

Ambar Chakravarty *

Department of Neurology, Vivekananda Institute of Medical Science, 1E 1202, Avishikta II, Calcutta 700 078, India

ARTICLE INFO

Article history:
Received 13 September 2009
Accepted 8 October 2009

SUMMARY

Creativity is a complex neuro-psycho-philosophical phenomenon which is difficult to define literally. Fundamentally it involves the ability to understand and express novel orderly relationships. The creative process involves four stages – preparation, incubation, illumination and verification. A high level of general intelligence, domain specific knowledge and special skills are necessary pre-requisites. It is possible that in addition, some creative people might have architectural alternations of specific portions of the posterior neocortex. Associated with such pre-requisites, the process of creative innovation (incubation and illumination stages) necessitates the need for an ability of divergent thinking, a novelty seeking behavior, some degree of suppression of latent inhibition and a subtle degree of frontal dysfunction. The author hypothesizes that these features are often inter-linked and subtle frontally disinhibited behavior is conducive towards creativity by allowing uninterrupted flow of creative thought possessing and opening up new avenues towards problem solving. Perhaps the most essential feature of the creative brain is its degree of connectivity – both inter-hemispheric and intra-hemispheric. Connectivity correlates or binds together functions of apparently structurally isolated domains on brain modules sub-serving different functions. It is felt that creative cognition is a self rewarding process where divergent thinking would promote connectivity through development of new synapses. In addition, the phenomenon of synaesthesia has often been observed in creative visual artists. Creative innovation often occurs during low arousal states and creative people often manifests features of affective disorders. This suggests a role of neurotransmitters in creative innovation. Dopaminergic pathways are involved in the novelty seeking attitude of creative people while norepinephrine levels are depressed during discovery of novel orderly relationships. The relationship between mood and catecholamines and that of creative cognition is often in an inverted U-shaped form. It is hypothesized that that subtle frontal dysfunction is a pre-requisite for creative cognition but here again the relationship is also in an inverted U-form.

Definition and concept

> You see things; and you say "why" but I dream things that never were; and I say "why not."
>
> – George Bernard Shaw

These few lines of George Bernard Shaw beautifully illustrate the basic concept of creativity which essentially is an abstract phenomenon. It is a complex neuro-psycho-philosophical concept which is difficult to define literally. The Wikipedia defines creativity as a mental and social process involving the generation of new ideas or concepts; or new association of the creative mind between existing ideas or concepts. Creativity is fuelled by the process of either conscious or unconscious insight. An alternative conception of creativeness is that it is simply the act of making something new (http://www.wikipedia.com). Recently Meyers and Gerstman [1] compiled the 'unconventional wisdom from 20 accomplished minds' in their book, 'Creativity'. Here, while a famous American playwright (Edward Albee) comments that 'the only thing that separates the creative from the non-creative is the fact that creative people are not content merely to have the experience, but insist on commenting on it'; one famous architect (Daniel Libeskind) writes that 'I think creativity is something eternal, because it is an encounter with a moment of time – creativity is not only the search for the new, it can be a rediscovery on the newness of thousands of years ago, which is still unsurpassed in some way'; according to a famous author (Erica Jong). 'Creativity is mysterious ..... a creative person is someone who sees the world differently, and does not accept that structures that most people unthinkingly accept'; a musician feels 'you cannot quite write directions on how to be creative – it's something that just happens because that is what creative people are all about'; and lastly a contemporary artist of much fame (Chuck Close) feels' ..... The most exciting thing in the visual arts is to see something that actually does not look like art' (my hyphens). So you see the divergent views about creativity even amongst creative people.

* Tel.: +91 33 24843283.
E-mail address: saschakra@yahoo.com

0306-9877/$ - see front matter © 2009 Elsevier Ltd. All rights reserved.
doi:10.1016/j.mehy.2009.10.014

The reason probably is that creativity (like intelligence) is often domain specific.

I particularly like the concept proposed by Bronowski [2]. Creativity is finding unity in what appears to be diversity. Great art works have a myriad of colours and forms and great musical works have a large variety of melodies and rhythms, but in both paintings and symphonies, the artist is able to develop a thread that unites diverse elements and displays order. Creative scientists such as Copernicus was able to see order in what appeared to be a disorderly solar system and Einstein was able to see the thread that unites matter and energy. Establishing the root of this novel orderly relationship through the eyes of a neuroscientist would be the prime objective of this article. In doing so I would first make a critical review of proposed concepts of creative cognition, suggest some new ones which I would try to prove to be essential in the genesis of the cognitive process and would then try to hypothesize on an all embracing conceptual construct for creative cognition and output. And I guess this would be a daunting task.

Rabindranath Tagore – a brief introduction

Before proceeding further I feel it would be prudent to introduce the genius of Rabindranath Tagore (1861–1941) to western readers as I shall be making frequent references to his works during the course of this article. Tagore is the national poet of India and two of his songs have been adopted as the national anthems of two independent nations namely India and Bangladesh. Basically he was a man of letters and during his long life he wrote innumerable number of poetries, over two thousands songs, several short stories, novels and essays and composed music for several of his own songs. He is the first Asian to get the Nobel Prize in any discipline in 1913 and in literature for his book of songs *Geetanjali* (a bouquet of songs) which was translated in English by the famous Irish poet W.B. Yates. Tagore's complete literary works are contained in as many as thirty volumes. Later in life he took up painting and painted over two thousands drawings and paintings which had been exhibited in several art galleries in Europe, Japan and the Americas. Some art critics had even compared his art works to those of the great masters. Above every thing he was a philosopher and a nationalist who denounced his Knighthood in protest against the atrocities of the then British rulers.

Creativity theory

Years ago Graham Wallas [3] suggested that creativity has four stages: preparation, incubation, illumination and verification. Preparation is the acquisition of the skills and knowledge that allow a person to create. Einstein developed superb skills in physics and mathematics before he made his discoveries and Pablo Picasso learned to draw forms and mix colours (first from his father and then at art schools in La Coruna, Barcelona and Madrid and later with the older painters of Montmartre, Paris) before he painted his masterpieces. Rabindranath Tagore, though had little formal school education, was educated at home by eminent scholars in Calcutta and later in London and was an avid reader of Indian and Western literature and an astute observer of everything that he saw during his worldwide travels even up to late in his life. That was his 'preparation'. Interestingly he never received any formal art training but emerged later in life as a most successful and creative painter (nearly 2000 paintings to match his 2000 songs and innumerable poetries). I suppose it was only possible for his keen observation of works of other artists (Indian, Western and even aboriginal). His 'preparation' phase was life long.

Is such a preparation phase always needed for creative innovation? Chance discoveries in science are however not too uncommon. However, it appears that the scientists (e.g. Archimedes or Sir Isaac Newton) who made such discoveries must have been prepared mentally and intellectually to grasp the significance of these accidental events or chances. It indeed is the 'prepared mind' [4] that enables creators to perceive the importance of the phenomenon they observed. It is highly likely that an 'incubation phase' of ideas is needed for this 'preparedness'. The observation and grasping or its significance constitutes what is described in psychological literature as the "Aha!" experience. Historically, I would prefer to call this the "Eureka" experience. This is what – Wallas [3] termed illumination. In science, the hypotheses arrived at need to be proved by experimentation and that is the stage of verification of Graham Wallas [3]. It must be remembered of course that in science, not many discoveries are made accidentally (hence may lack the 'Aha' or 'Eureka' experience) but results from a series of conscious steps (not just subconscious incubation). Thus the categorical staging system does not work well in all aspects of the abstract concept of creativity and a general term like 'creative innovation' (as proposed by Heilman et al. [5]) may be easier to understand. I wish to re-examine the involved issues so far noted and suggest new thoughts.

Pre-requisites or preparation

General intelligence

Intelligence is supposed to be domain specific just like Creativity in general. Domain specific intelligence is difficult to assess. A Cricketer who innovated the reverse swing or the reverse sweep or innovates a batting stroke for an odd ball which is not described in cricketing books, is certainly creative. But he need not have been a 'bright' boy at school. The same is true for a modern day Indian innovative artist whom I know from school. However, if you define intelligence as a measure of a person's ability to acquire the knowledge and skill that will allow them to adapt to their environment [6], a basic level of intelligence would be a pre-requisite for any creative endeavour. However, the relationship may not be a linier one. Barron and Harrington [7] found a weak relationship between creativity of architects and their IQ. They concluded that above an IQ of about 120, the IQ does not predict creativity as much as it does if the IQ is below 120. This suggests that there is an IQ threshold. A person needs to be above the threshold to be intelligent enough to learn and have sufficient knowledge about the domain of their activity. Thus, intelligence is a necessary but not sufficient component of creativity.

Knowledge and special talents

A person may have a specific cognitive disorder, for example, a learning disorder like dyslexia or even autism, but can have creative talents in another field even to the level of a creative genius. Such people are often referred as 'savants' and while I would not discuses the possible brain mechanisms of savants at this stage, some concrete examples from history would highlight the point. Writings of Leonardo da Vinci, examined recently [8], suggest had he probably had developmental dyslexia. However, the world has yet to see such an expression of multi-domain creativity as observed in Leonardo. Both Picasso and Einstein, most likely suffered from learning disorders.

Thus, general intelligence (which may be unaltered in dyslexia) or what Spearman [9] called the "g" factor, alone can not explain specific disabilities or specific talents and several theories have placed more emphasis on special factors called the "S" factor.

Weisberg [10] concluded that domain specific knowledge is a pre-requisite for creativity. This knowledge in human is generally