

Latent inhibition, alpha waves, increased cortical arousal, noradrenalin...

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Looking for inspiration
by Helen Phillips

PEOPLE have speculated about their own creativity for centuries - perhaps ever since we became able to think about thinking. Because creative thought just seems to "arrive", the credit has been laid at the feet of gods and spirits or, recently, the id or the subconscious mind. Whatever it is, it is thinking at the edge, at the very fringes. The only bit of the creative process we actually know about is the moment of insight, yet creative ideas and projects may incubate beyond our awareness for months or even years. Not surprising, then, that creativity has long eluded scientific study.

In the early 1970s, it was still seen as a type of intelligence. But when more subtle tests of IQ and creative skills were developed in the 1970s, particularly by the father of creativity testing, Paul Torrance, it became clear that the link was not so simple. Creative people are intelligent, in terms of IQ tests at least, but only averagely or just above. While it depends on the discipline, in general beyond a certain level IQ does not help boost creativity; it is necessary, but not sufficient to make someone creative.

Because of the difficulty of studying the actual process, most early attempts to study creativity concentrated on personality. According to creativity specialist Mark Runco of California State University, Fullerton, the "creative personality" tends to place a high value on aesthetic qualities and to have broad interests, providing lots of resources to draw on and knowledge to recombine into novel solutions. "Creatives" have an attraction to complexity and an ability to handle conflict. They are also usually highly self-motivated, perhaps even a little obsessive.

Less creative people, on the other hand, tend to become irritated if they cannot immediately fit all the pieces together. They are less tolerant of confusion. Creativity comes to those who wait, but only to those who are happy to do so in a bit of a fog.

But there may be a price to pay for having a creative personality. For centuries, a link has been made between creativity and mental illness. Psychiatrist and author Kay Redfield Jamison of Johns Hopkins University in Baltimore, Maryland, who has bipolar disorder, found that established artists are significantly more likely to have mood disorders. But she also suggests that a change of mood state might be the key to triggering a creative event, rather than the negative mood itself.

Some features of schizophrenia are also thought to be more common in creative types, according to psychiatrist Gordon Claridge of the University of Oxford. He uses a "schizotypy scale" to record features of the illness that are not pathological by themselves, including experiencing hallucinations, hearing voices, having disorganised thoughts, believing in magic and so on. People with these traits tend to score highly on tests of lateral, divergent and open thinking. But those who score very highly on such tests find this kind of thinking can be very destructive. Intelligence can help channel this thought style into great creativity, but when combined with emotional problems, lateral, divergent or open thinking can lead to mental illness instead.

Jordan Peterson, a psychologist at the University of Toronto, Canada, believes he has identified a mechanism that could help explain this. He says that the brains of creative people seem more open to incoming stimuli than less creative types. Our senses are continuously feeding a mass of information into our brains, which have to block or ignore most of it to save us from being snowed under. Peterson calls this process latent inhibition, and argues that people who have less of it, and who have a reasonably high IQ with a good working memory can juggle more of the data, and so may be open to more possibilities and ideas. The downside of extremely low latent inhibition may be a confused thought style that predisposes people to mental illness. So for Peterson, mental illness is not a prerequisite for creativity, but it shares some cognitive traits.

But what of the creative act itself? One of the first studies of the creative brain at work was by Colin Martindale, a psychologist from the University of Maine in Orono. Back in 1978, he used a network of scalp electrodes to record an electroencephalogram, a record of the pattern of brain waves, as people made up stories. Creativity, he showed, has two stages: inspiration and elaboration, each characterised by very different states of mind. While people were dreaming up their stories, he found their brains were surprisingly quiet. The dominant activity was alpha waves, indicating a very low level of cortical arousal: a relaxed state, as though the conscious mind was quiet while the brain was making connections behind the scenes. It's the same sort of brain activity as in some stages of sleep, dreaming or rest, which could explain why sleep and relaxation can help people be creative.

However, when these quiet-minded people were asked to work on their stories, the alpha wave activity dropped off and the brain became busier, revealing increased cortical arousal, more corraling of activity and more organised thinking. Strikingly, it was the people who showed the biggest difference in brain activity between the inspiration and development stages who produced the most creative storylines. Nothing in their background brain activity marked them as creative or uncreative. "It's as if the less creative person can't shift gear," says Guy Claxton, a psychologist at the University of Bristol, UK. "Creativity requires different kinds of thinking. Very creative people move between these states intuitively." Creativity, it seems, is about mental flexibility: perhaps not a two-step process, but a toggling between two states.

In a later study, Martindale found that this change in activity was particularly noticeable on the right side of the brain. However, people who had the connections between the two sides of their brain severed to treat intractable epilepsy seemed to become far less creative, showing that communication between the sides of the brain is also important.

Researchers are now trying to identify some of the specific anatomy of creativity. Brain studies of people with particular types of creativity show, perhaps not surprisingly, that the active areas are determined by the specialist knowledge being used. Language, imagery, spatial awareness and so on - each skill is localised to some extent to a particular brain part or parts. Mathematicians and physicists may have larger parietal lobes, important for spatial representation, while writers may have more widely distributed language regions in the frontal and temporal lobes, perhaps spreading across both sides, when they are normally confined to the left.

But it's not just these speciality areas that are active. Using information creatively needs coordination between many areas. "Creative synthesis requires a new pattern, to put the brain in a state where a large number of areas are simultaneously active," says Claxton. When we concentrate in a less creative way, such as when reading the gas bill, there are fewer active centres and less synthesis.

Ingegerd Carlsson, a psychologist from the University of Lund in Sweden, and her colleagues found something that they think might link different forms of creativity. When people were performing a creative task - trying to list as many uses for an object as they could - the frontal lobes of their brain were noticeably more active. The frontal lobes are thought to help people change tasks and strategies and to shift attention from task to task.

The frontal lobes also help coordinate the connectivity between different brain areas by controlling the release of signalling chemicals, says neurologist David Beversdorf of Ohio State University in Columbus. One thing that relaxed states of mind, sleep and depression - all linked with increased creativity in some way - have in common are low levels of a brain signalling chemical called noradrenalin, or norepinephrine. This chemical controls how easily neurons "talk" to each other. Low levels of it seems to encourage broad networks of neurons to communicate, whereas higher levels seem to focus that activity into tighter, smaller networks. Treating people with precursors to noradrenalin seems to hinder their ability to solve creative word puzzles, says Beversdorf, while drugs such as propranolol, which block the chemical, can help people do better at tasks such as spotting anagrams.

Paul Howard-Jones, who works with Claxton at Bristol, believes he has found another aspect of creativity. He asked people to make up a story based on three words and scanned their brains using functional

magnetic resonance imaging. In one trial, people were asked not to try too hard and just report the most obvious story suggested by the words. In another, they were asked to be inventive. He also varied the words so it was easier or harder to link them.

As people tried harder and came up with more creative tales, there was a lot more activity in a particular prefrontal brain region on the right-hand side, extending backwards towards a deeper region called the anterior cingulate cortex. These regions are probably important in monitoring for conflict, helping us to filter out many of the unhelpful ways of combining the words and allowing us to pull out just the desirable connections, Howard-Jones suggests. It shows that there is another side to creativity, he says. The story-making task, particularly when we are stretched, produces many options which we have to assess. So part of creativity is a conscious process of evaluating and analysing ideas. The test also shows that the more we try and are stretched, the more creative our minds can be.

But to be truly creative needs more than just the right personality and the right brain areas and networks. It's about using them effectively. Skills, situations and our social setting can shape our creativity just as dramatically as the brain resources we are born with. The most creative people also use the different rhythms of the day, the weekends and the holidays to help shift focus and brain state. They may spend two hours at their desk then go for a walk, because they know that pattern works for them, and they don't feel guilty.

And creativity need not always be a solitary, tortured affair, according to Teresa Amabile of Harvard Business School. Though there is a slight association between solitary writing or painting and negative moods or emotional disturbances, scientific creativity and workplace creativity seem much more likely to occur when people are positive and buoyant.

In a decade-long study of real businesses, to be published soon, Amabile found that positive moods relate positively to creativity in organisations, and that the relationship is a simple linear one. Creative thought also improves people's moods, her team found, so the process is circular. Time pressures, financial pressures and hard-earned bonus schemes on the other hand, do not boost workplace creativity: internal motivation, not coercion, produces the best work.

Another often forgotten aspect of creativity is social. Vera John-Steiner of the University of New Mexico in Albuquerque and author of *Creative Collaboration* (Oxford University Press, 2000) says that to be really creative you need strong social networks and trusting relationships, not just active neural networks. One vital characteristic of a highly creative person, she says, is that they have at least one other person in their life who doesn't think they are completely nuts.