

Teaching Creativity

The concept of creativity is a vexing one for science, and philosophy and, not surprisingly, for teachers. There is no doubt creativity is a highly desired trait that all healthy societies value. It must be acknowledged that creativity is a threat to conservative values. But the case could be made that the success of our species is down to the advances that have come from great moments of creativity. As we have pushed up against the frontiers of our understanding, or when we have been stuck in some unworkable paradigm, it has taken someone to have the brilliance of divining a solution, an idea that has not been thought of before.

There is some dispute over what constitutes creative thought. One school of thought excludes scientific advancement. They claim that the scientific facts exist, and what separates the greats like Einstein and Newton is their detective work, not some divine inspiration. They point out that if Newton had not 'discovered' gravity, someone else would have. In contrast, the painting *The Starry Night* could only have been created by Vincent van Gogh. A Mozart symphony is exclusively Mozart's.

For this essay I take the view that creativity is the production of a new, and in some ways valuable, product; thus science is included. I make a case for this is made by citing the great moments of science from Newton and Einstein in the world of physics. Both changed the very heart of scientific thought. Then there was Niels Bohr who proposed quantum physics, a concept that is so counter-intuitive that the Nobel Prize-winner Richard Feynman mused that if anyone said they understood it, that amounted to proof they did not. But quantum physics is real, and it works.

The popularity of Ken Robinson—he of TED Talks fame—is reflected in educators' approval of the worth of creativity. There is general agreement that if we are to continue to develop on a sustainable and inhabitable planet we need to create new solutions to the emerging problems. Sir Ken contends that education must include teaching our students to be creative. It makes perfectly good sense to teach creativity.

But how do you teach creativity? By definition, creativity is a phenomenon whereby something new and valuable arises. How do you teach your students to think about something that you don't know and at the time neither do they!

Not surprisingly, there is a mountain of literature describing various theories about the characteristics of creativity, what defines it, and the like, but how can you articulate something that doesn't exist? Any creative event only happens once; at that time it is unique and new. How do you teach that?

So here is where I express my dilemma. If I concede that all our prior learning has been acquired either through our genetic inheritance or lessons from our physical, social, or intellectual environment and is stored as memories, how do we produce something that is unique and new?

I will argue that you can't teach a child to be creative; you can only produce the environment in which a child can arrive at a creative conclusion. The answer lies in producing the conditions under which the rich memories an individual possesses can be accessed in a state of mind that allows for novel combinations to be applied to a presenting problem.

I have argued in other places that the popular use of the computer as a model for how we learn is inaccurate and leads to a simplistic view of how we should teach. In a simple schematic representation, the model is information in, information out (or more cynically, GIGO—Garbage In, Garbage Out).

This linear approach ignores the complexity of the mind and the power of the subconscious. Any model of human computation must account for the emotional content of the situation as well as the memories and beliefs the individual brings to that situation.

In the classroom, the student gets information in, a stimulus from the environment. The stimulus is subjected to interrogation from the brain for recognition and predicted events. Through previous experiences stored as memories, implicit-unconscious (feelings) or explicit-cognitive (beliefs), he or she has an expectation of what will happen and will act accordingly. This process takes place unconsciously.

This is the first of the conditions that build to the hypothesis presented in this paper. I argue that if we were asked whether we thought about what we were about to do we would claim we did. This implies our decisions are determined by our conscious attention to our actions. This is the position of *free will*.

This is not the place for an argument about whether or not we have free will or if everything is determined; that is well beyond this paper. However, I will argue that at any given instant we will act, speak, or move, and we will do so because a decision has already been made. It is determined by our memories.

The first to reveal the idea that we make decisions before we are aware of them was Benjamin Libet, in the 1970s. Libet showed in a landmark experiment that when faced with a task that involved movement the participants in the experiment had already activated that movement before they were conscious of making that decision. He identified specific activity in the brain before the subjects 'made their decision'.

This phenomenon has been studied repeatedly, and the proof has been established. At the Max Planck Institute for Human Cognitive and Brain Sciences in Germany, researchers could predict decisions up to eight seconds prior to the subject's conscious 'choice'! This seems outrageous, but it refers to a specific type of decision-making. It seems the brain and body will have already decided on the best action before our consciousness is alerted.

This independent, unconscious decision-making is easy to accept if we are thinking about reflex responses, like jumping out of the way of a threatening object. But it is another matter to accept that at the time we are called to act our thought processes have gone on without our

control.

It may help with the understanding of this process if you think about how you construct a sentence when in discussion. You start the sentence with no conscious plan of how that sentence will play out. If you are in doubt, try to construct every sentence in a conversation before you say it. If you engage in a discussion using this conscious approach, at best you will sound humorous and at worst quite confused—or you will seem to be mimicking the modern politician who fears a slip-up that will be played and replayed on the nightly news.

This brings me to the first argument about creativity. That is, we need to front-load our minds with rich, abundant memories so our unconscious mind has a wealth of material to construct a response. These memories are the components of creativity.

Plato illustrated the limitation of our decision-making in *The Republic*. In a reported discussion between Socrates and his brother, the following scenario was discussed: Consider the plight of slaves who spent their whole life chained at the back of a cave. These slaves were chained in such a way so they could not see outside the entrance but could make out the shadows of passing animals and people.

The claim was that the cave dwellers' understanding of the world would be limited to what they could perceive and therefore that was all they could know. If they were released and moved out of the darkness, then they would be 'enlightened.'

This story illustrates the limitations of the decisions we can make to the amount of 'memory options' we have available. And the more we know, the more creative our decisions can be.

With the example above and using the discussion illustration to debate a particular point of view, I can and will use information that is most up to date. The more information I have, the better the argument I can construct, but I must remember that what I say is decided for me by the unconscious me. Most teachers and researchers will have experienced the feeling of really gaining deep understanding of a problem when they are discussing it with someone else. This *aha* moment is the conscious recognition that our unconscious, creative thinking brain has found a better combination of the 'facts.'

This optimum memory can be the unique combination of specifics combined in a one-off decision. It follows that for a really creative decision, the more memories the individual has, the more imaginative the options that can be constructed.

Decisions are made by combining recollections from all across the brain and at every level. This web of information (stored memories) is interconnected. For decisions that involve cognition, these interconnections are examined, and the optimum action is taken on the available knowledge.

There is a position taken by a number of futurists who claim we have no need of remembering facts; we carry these with us in our electronic devices. My claim is that creativity comes from

unusual combinations of memories—and I can hear some people saying, ‘Well, we can just put in a randomly generated combination of facts to replace the creative process.’ But computers are programmed, and the combinations are limited to the programming. Computers are still GIGO!

The process of picking out a specific memory or connection of memories to combine to address a particular problem is described as our ‘working memory’; it’s referred to in educational-speak as ‘deep learning.’

Working memory is the faculty by which cognitive thinking takes place. The two parts of the brain primarily involved with this are the frontal lobes and the hippocampus. One of the complications about creative thinking is that both these areas specialize in efficient pattern-recognition. The hippocampus in particular is critical; it’s interested in the organized distribution of long-term memories and their retrieval. It is often described as the librarian that manages the real ‘information in and information out.’

This is particularly the case when quick decisions are required. When pressed for action, the mind will decide to act based on the most trusted memory. The need to immediately address the situation initiates elevated levels of stress, the driving force of action. It is the level of stress, or more to the point, the elimination of stress, that I believe causes the second and most significant condition for truly creative thought to occur.

The creative action requires something new or unique. It is that combination of memories that have not been applied in the past. Therefore, the usual function of the hippocampus, the tidy organizational behaviour, works in direct opposition to creativity. Referring back to the understanding that our unconscious minds decide for us, we must accept that the hippocampus stands in the way of the creative process.

However, there is evidence that during sleep or deep relaxation the hippocampus’s function as librarian is inhibited while the memories of the day are transferred to the neocortex. The strict monitoring that is a hallmark of all librarians is off guard, and there is the opportunity for unusual combinations to emerge.

Another phenomenon that supports this reduction of predetermined solutions to problems is cited in recent work by Rafael Weizmann, from the Institute of Science in Rehovot, Israel. With his team, he identified those activities that involve concentrated effort creating a pattern of activity across the brain. That pattern persisted as what he called ‘echoes’ of that same pattern when there was no thought about the initial work. This confirms that while the brain is consciously at rest from a problem, the unconscious cognitive activity towards solving that problem continues.

This echo is not related to the hippocampus but to the dorsal anterior cingulate cortex, which is part of frontal lobe. It resembles a collar surrounding the front part of the corpus callosum. Now, the corpus callosum is the area of the brain that coordinates memories between the hemispheres. This is not part of the memory consolidation, but it illustrates the brain’s capacity

to consider problems beyond the period of cognitive attention. How many times have you struggled to remember someone's name and failed, only to have that name pop into your mind later when you were not thinking about it?

History is full of creative moments when great discoveries have been made at the most unusual, often relaxing, times. There is the legend of Archimedes observing the displacement of water while taking a bath, which solved a problem about the purity of gold. He got so excited he took to the streets naked, crying, 'Eureka!' The German chemist Friedrich August Kekulé discovered the ring shape of the benzene molecule after having a daydream of a snake seizing its own tail (this is the 'endless knot' symbol). This vision, he said, came to him after years of studying the nature of carbon-carbon bonds. He then dreamt the solution.

Another clue to the importance of allowing historically diverse memories to offer combinations in the working memory in order to arrive at creative solutions comes in the link between mental illness and creativity. There is some truth in the saying, 'It's a fine line between genius and madness,' and studies have consistently found a correlation between the two. It seems to be emerging from the recent work of Andreas Fink and his colleagues that the link is more likely to exist with schizoid types. These are people whose symptoms are predominantly related to those of full-blown schizophrenia, but they have intact working memory.

Some individuals possess a negative trait that makes them socially withdrawn and disorganized. Others have a more positive outlook and experience unusual perceptions for day-to-day events; they have thin mental boundaries that allow different concepts residing in areas of the cortex to 'bleed' into each other. This mixing of concepts at the sub-cognitive level promotes unusual combinations that can lead to different and creative ideas.

It is a common theme that many of the great creative leaps in our history take place when two conditions are met. The first is the person has spent a long time considering the problem, investigating all possible solutions. The second is that this primed mind is disengaged, allowing us to resist the conventional wisdom of trying harder. From the evidence, it seems it is the ability to let go and trust the brain that allows us to come up with the unusual solutions.

The problem for schools, particularly in the contemporary model, is that the focus on outcomes-based learning plus the pressure to increase learning outcomes assembles a system that is completely contrary to that required for creativity.

So, my thesis is that to uncover creativity we need to have the students spend time preparing their brains with a rich and diverse array of memories that will allow them to make the inventive leap. Then we need the students to immerse themselves in the problems at hand. Those who experience *aha* moments are most likely to be those who have worked hardest at solving their problems.

Then we have to set the creative practice free; somehow, we must de-stress the process. Perhaps we could duplicate the practice of a lot of modern companies, such as Apple, where they devote one day just to think about whatever they like.

Somehow the students need to be free of 'assessment'! This is a challenge that is beyond contemporary educational bureaucracies.