# Artistic creativity and the brain: The impact of creativity on Art

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**Abstract:** Art is a product of human creativity; it is a superior skill that can be learned by study, practice and observation. Modern neuroscience and neuroimaging enable study of the processes during artistic performance. Creative people have less marked hemispheric dominance. In this research paper I will discuss the intersection between art and neuroscience from the perspective of a particular artist. I have collaborated on several scientific studies into the effects of art on the brain and behavior, looking in particular at the phenomenon of "visual indeterminacy." This is a perceptual state in which subjects fail to recognize objects from visual cues. I will briefly review some of this work and show how my attempts to understand the science behind visual indeterminacy led me to collaborate with psychophysicists and neuroscientists. This chapter reviews the changes produced by age on various aspects of artistic painting, particularly creativity and actual production. Aging in trained painters is often accompanied by a decline in creativity, which in turn is due to the cognitive decline related to aging. It has been argued, however, that aging does not cause a decline, but only changes in style and content. The two views are not mutually exclusive, and we present examples illustrating both aspects. We also show that, in addition to cognitive changes, impairment of sensory organs, especially vision, and of the bones and joints, may also produce marked changes in an artist's production and style.

Keywords: Neuroscience, Visual Indeterminacy, human creativity, art, brain, cognitive changes.

**Introduction-**

What is it about a creative work such as a painting or piece of music that elicits our awe and admiration? Is it the thrill of being shown something new, something different, something the artist saw that we did not?

**"Others have seen what is and asked why. I have seen what could be and asked why not. "-- Pablo Picasso**

Do we need to be crazy to be creative? The idea that some people see more possibilities than others is central to the concept of creativity. What can art tell us about how the brain works? And what can the brain tell us about how we perceive and create art? Humans have created art throughout history and its significance has been an endless source of fascination and debate.

**"Art is a lie that makes us realize the truth." -- Pablo Picasso**

There is an increasing amount of scientific evidence that proves art enhances brain function. It has an impact on brain wave patterns and emotions, the nervous system, and can actually raise serotonin levels. Art can change a person's outlook and the way they experience the world.

Being an artist requires generosity of spirit, the willingness to see, hear, and feel. Art is not an ornament. It's a language. It can create a space to share and transcend boundaries.

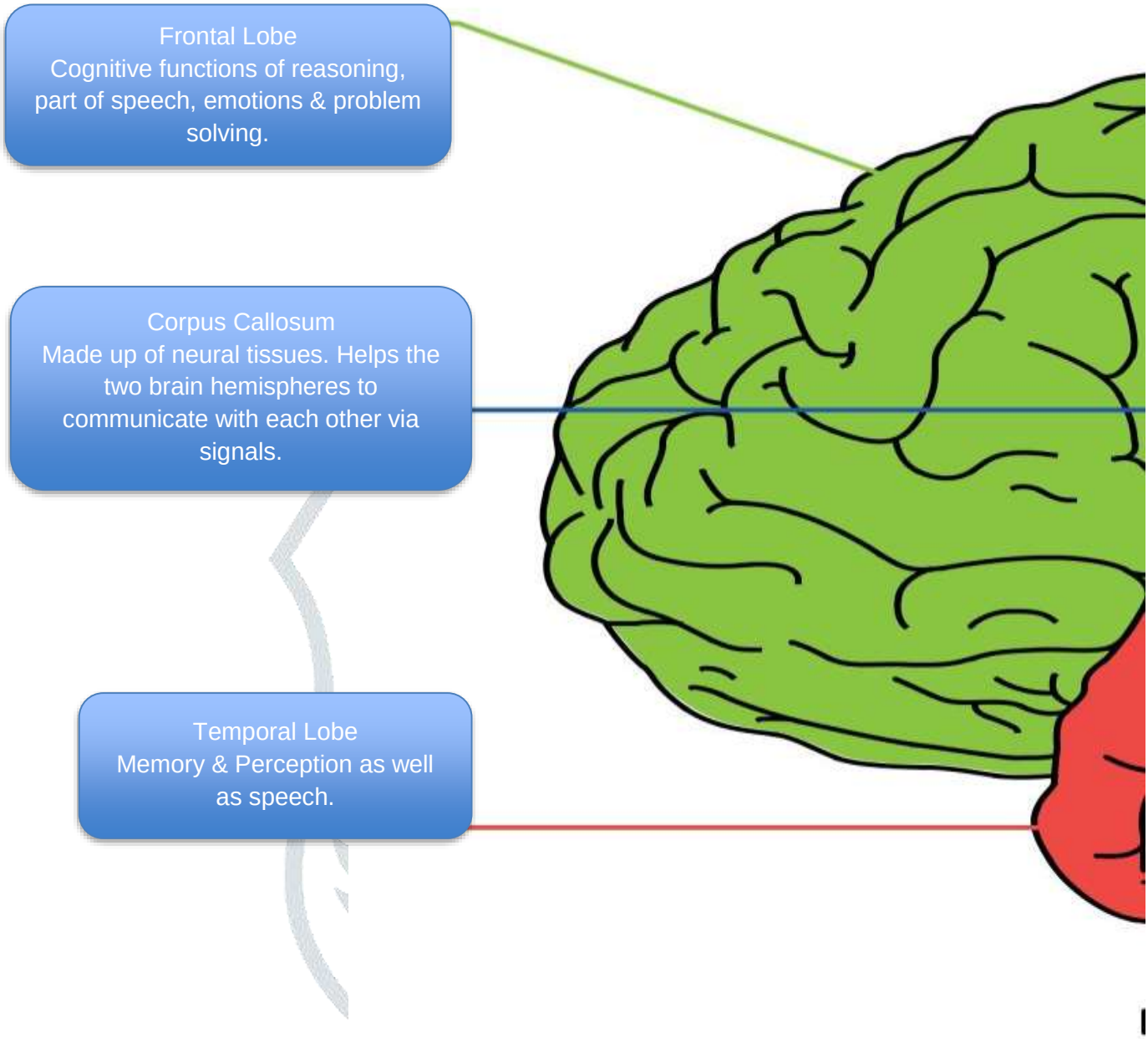


*Figure 1*

The current theme of the critical role of the arts in providing students with a well-rounded education that meets the needs of the whole child promotes thoughts about how the arts can "increase students' college-,career-, and citizenship-readiness in all subjects as well as keep them engaged in school and contribute to their social and emotional health." The arts are not optional, separate entities that can be isolated into short periods of playing with clay. The arts, by nature, are opportunities for creativity. There is creativity for personal expression in art interpretation as well as in artistic production and performance.

The increasing buzz about a creativity crisis comes at a time when neuroscience and cognitive Science research are increasingly providing information that correlates creativity with intelligence; academic, social, and emotional success; and the development of skill sets and the highest information processing (executive functions) that will become increasingly valuable for students of the 21st century.

The neurological term for the processes directed by these networks is executive function or, in education terminology, higher-process thinking. Some of the ways to describe some of the executive functions when relating the arts to creativity and the thinking processes include:

1. Conceptual thinking and transfer of knowledge
2. Judgment
3. Critical analysis
4. Induction and deduction
5. Prior knowledge evaluation (not just activation) for prediction
6. Delay of immediate gratification for long-term goals
7. Recognition of relationships for symbolic conceptualization
8. Evaluation of emotions, including recognizing and analysing response choices
9. The ability to recognize and activate information stored in memory circuits throughout the brain's cerebral cortex that are relevant to evaluating and responding to new information or for producing new creative insights (academic, artistic, physical, emotional, or social).

**People with creative personalities really do see the world differently-**

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The idea that some people see more possibilities than others is central to the concept of creativity.

Psychologists often measure creativity using divergent thinking tasks. These require you to generate as many uses as possible for mundane objects, such as a brick. People who can see numerous and diverse uses for a brick (say, a coffin for a Barbie doll funeral diorama) are rated as more creative than people who can only think of a few common uses (say, for building a wall).

The aspect of our personality that appears to drive our creativity is called openness to experience, or openness. Among the five major personality traits, it is openness that best predicts performance on divergent thinking tasks. Openness also predicts real-world creative achievements, as well as engagement in everyday creative pursuits.

As Scott Barry Kaufman and Carolyn Gregoire explain in their book Wired to Create, the creativity of open people stems from a "drive for cognitive exploration of one's inner and outer worlds".

This curiosity to examine things from all angles may lead people high in openness to see more than the average person, or as another research team put it, to discover "complex possibilities lying dormant in so-called 'familiar' environments".

In 1942, Pablo Picasso dismantled an old bicycle and attached the handlebars to the seat to bring out the resemblance to the head of a bull. It's hard not to be a bit charmed. It is a move that helpfully gives us a more accurate idea of creativity. The items Picasso used were already very familiar to everyone. The key initiative was that he rearranged them to make each part more valuable than it had been in its previous role. This act of combination tends to be central to the creative act. There is very little that is entirely new under the sun, but to be creative is to learn to see how apparently unlikely elements might fit together in a fruitful new arrangement. One might borrow a way of organising information from the world of computers and apply it to the management of a gym. One might take an idea associated with the history of Ancient Greece and set it to work within the running of a modern school. One could take a way of speaking popular in Japan and collide it with contemporary English diction. Essentially, creativity means spotting an opportunity to improve things through recombination. The German philosopher Hegel put the idea in its grandest terms: we are creative, he wrote, when we 'strip the world of its stubborn foreignness and adapt it to our needs.' Usually, we just put up with matters that are frustrating or disappointing. But when we get creative, we adapt what is to hand – combining, reorganising, starting afresh – so that it better matches our interests and ideals. It is the opposite of feeling stuck and resigned, it is a refusal to accept the status quo. The creative person is someone particularly committed to the idea that there must be a better way of going about things.

Pablo Picasso, Tête de taureau (Bull's Head), 1942

**Seeing things that others miss-**

Another well-known perceptual phenomenon is called in attentional blindness. People experience this when they are so focused on one thing that they completely fail to see something else right before their eyes.
In a famous illustration of this perceptual glitch, participants were asked to watch a short video of people tossing a basketball to one another, and to track the total number of passes between the players wearing white.

**Opening our minds: is better?**

It might seem as if open people have been dealt a better hand than the rest of us. But can people with uncreative personalities broaden their limited vistas, and would this be a good thing?
There is mounting evidence that personality is malleable, and increases in openness have been observed in cognitive training interventions and studies of the effects of psilocybin (the psychedelic compound in magic mushrooms).
Openness also increases for students who choose to study overseas, confirming the idea that travel broadens the mind.
But there is also a dark side to the "permeability of consciousness" that characterises open people. Openness has been linked to aspects of mental illness, such as proneness to hallucination.
So despite its appeal, there may be a slippery slope between seeing more and seeing things that are not there.
So, from different personalities emerge different experiences, but we should always remember that one person's view is not necessarily better than another's.

**Creativity and the Relational Mind-**

"'Creative' is a word I do my very best never to use if it can be avoided," wrote Cohen (1999). That was Cohen's position a decade ago. In recent years, he has done much reflection and given many talks on this topic. Buchanan (2001), in his 2000 presidential address at the American Association for Artificial Intelligence, declared that AARON "is a much more talented and creative artist than most of us would claim to be" (p. 16). However, Cohen was and still is reluctant to consider AARON creative. Buchanan (2001) identified some of the reasons why AARON falls short of Cohen's measure of creativity:
"AARON will never make a choice to break the rules, nor will it reflect on those constraints as something that it might want to change… AARON has no sense of continuity or sense of experience from one drawing to the next" (p. 17). But Cohen's objection to the claims of machine creativity goes deeper.
In his recent reflections (Cohen, 2010), Cohen is explicit about what creativity is not: It is not simply divergent thinking; nor is it simply algorithms and symbol manipulations. What then is creativity? The answer given by Cohen (2010) is as succinct as it is profound:

*Creativity… lay in neither the programmer alone nor in the program alone, but in the dialog [sic] between program and programmer; a dialog resting upon the special and peculiarly intimate relationship that had grown up between us over the years. (p. 9)*

*Elsewhere he wrote: "Forty-three years in almost daily contact with a computer program… underscores a level of intimacy between programmer and program that would have been difficult to achieve with anything less"..*

'Creativity' is one of the most prestigious ideas of modern times and as a result, we often want to feel creative while lamenting that our lives don't give us sufficient opportunities to be so. But this impression may come down to an unfairly inflated and unhelpfully skewed notion of what creativity could actually involve. We are far too focused on creativity's dramatic high points within a narrow, cliched band of activities, like the writing of a prize-winning novel or the making a film that receives accolades at Cannes or Berlin. By this standard, almost no-one can be creative and creativity must remain an elite and even freakish anomaly entirely disconnected from ordinary life.

Essentially, creativity means spotting an opportunity to improve things through recombination. The German philosopher Hegel put the idea in its grandest terms: we are creative, he wrote, when we 'strip the world of its stubborn foreignness and adapt it to our needs.' Usually, we just put up with matters that are frustrating or disappointing. But when we get creative, we adapt what is to hand – combining, reorganising, starting afresh – so that it better matches our interests and ideals. It is the opposite of feeling stuck and resigned, it is a refusal to accept the status quo. The creative person is someone particularly committed to the idea that there must be a better way
of going about things.

**The Extended Mind Hypothesis-**

The extended mind is the antithesis of the encapsulated mind. Encapsulated mind refers to the assumption in traditional Western metaphysics that the mind functions as self-contained operations independent of the external environment, as evidenced by metaphors of mechanisms, modularity, or computer programs.

By contrast, the extended mind hypothesis (Clark, 2008; Clark & Chalmers,1998; Noë, 2009; Rowlands, 2010) states that the mind does not entail a brain event so much as an engagement with the world, a proposition consistent with the relational mind framework (Gergen, 2009).

As a condensed version of the four E (expanded, embodied, embedded, enactive) cognition (Protevi, 2007), the extended mind hypothesis puts much stock on embodiment of knowledge. Clark (2008) gives the example of running to catch a fly ball. According to conventional thinking, the catcher needs to build an internal representation of the world in order to calculate the forward trajectory of the ball. In the enactive framework of the extended mind hypothesis, by contrast, the catcher, in running to catch the ball, makes the most of environmental opportunities and information that is optically available during the projectile tracking tasks. Thus in the extended mind hypothesis, there is a shift of emphasis from representing an environment to continuously engaging that environment (Clark, 2008).

However, Cohen does not agree with the sharp dichotomy drawn by (Noe) 2004 claims that painting consists of dense cycle of situated, world- engaging activities. Clark (2008) explains:

*Painting is an ongoing process in which the eye probes the scene, then flicks back to the canvas, then back to the scene, and so on in a dense cycle of active exploration and partial, iterated cognitive uptake. It is this cycle of situated, world-engaging activity that constitutes the act of painting. (p. 170)*

Cohen also noted in painting the "feedback-controlled mode in which images get colored bit by bit and with constant adjustment of what's already there, until the colorist somehow knows he has it right" (Cohen, 2010, p. 6).

But he was quick to point out that "The continuous adjustment [of the colorist] is driven by the requirements of making a plausible object, but plausibility does not rest upon matching external colors" . More explicitly, Noë got it wrong, said Cohen:

*I think he's [Noë] quite wrong about this. To begin with, not all painting involves visually accessible scenes—my own doesn't, for example—and almost none of it corresponds to his description. Obviously, for example, the cave painters had nothing accessible outside their internal models of the animals they depicted. Impressionism was driven, in part, by a reaction against painters painting landscapes in their studios for several hundred years. Relatively, little of the painting for the past hundred years has conformed to this model of a situated, world-engaging activity.*

*When I taught drawing (from a model), I would sometimes use a stopwatch to record how the students spent their time.*

*In the first five minutes, they would look at the subject every 30s or so; in the second five minutes two or three times; in the third five minutes perhaps once or not at all.*

*People don't draw (or paint) what is out there, but what's in their heads, and they use the viewing time to update—to confirm or revise—those internal models. (Personal communication, 3/9/2011).*

Cohen went on to say:

*There's another element which Noë's account misses completely. Once a drawing or painting begins to exist, it is an object in its own right, and making (MAKING!) it has to answer to its own logic. Think about this with Picasso's (1910) cubism rather than his (1906) Gertrude Stein portrait, for example.*

**AARON the Gap Maker-**

Gaps are differences or discontinuities, anything that disrupts the continuity of presence. As such, gaps make absence visible and thereby prompting the mind to make inferences. Otherwise without gaps, the mind would be moving along sluggishly in a sea of homogeneity (Deacon, 2010). The gap between the self and the non-self-renders visible to the self an absence of knowledge about the other. The gap between humans and the machine is a bigger chasm—a discontinuity in being.
Cohen has capitalized on the gap making capacities of AARON since the very beginning: Unlike God who created humans in His own image, Cohen created AARON to be different. He said in his interview with *Scientific American Frontiers* in the mid 90's: "I'd be happier if AARON's work in the future were less like human work, not more like human work" (cited in Cornish, 2011, p.7).
As a programmer, Cohen's goal had always been program autonomy (Cohen,2009). But in 2009 when a newly developed and very general form generator brought it very close to that goal—AARON could now handle color, forms, and composition all on its own—Cohen suffered something of a crisis. The program did not need him anymore! In the aftermath of that crisis, Cohen had little to show beyond half a dozen small panels, printed in color except for the backgrounds, which had been left grey. That grey became increasingly intolerable to Cohen, and he pulled out paints and brushes simply to correct the source of his discomfort. He found that in so doing he had effected a startling transformation to the images, prompting a complete rethinking of how his images came into being in the first place (based on personal communication, 10/2/2011)

"Art is incomplete without the perceptual and emotional involvement of the viewer."
So states Alois Riegl, a Viennese art historian of the late nineteenth century. Since this pronouncement and even earlier, art historians have studied the impact of art on the viewer, more specifically, viewers' reactions to abstract and minimalist art. Despite its apparent simplicity, art historians find that the average viewer is far more intimidated by"Art is incomplete without the perceptual and emotional involvement of the viewer."
So states Alois Riegl, a Viennese art historian of the late nineteenth century. Since this pronouncement and even earlier, art historians have studied the impact of art on the viewer, more specifically, viewers' reactions to abstract and minimalist art. Despite its apparent simplicity, art historians find that the average viewer is far more intimidated bythe abstract art of, for example, Mark Rothko or Jackson Pollack, than by art that depicts recognizable images and scenes (otherwise known as "figurative art.")

We were curious to find out why, and so we spoke with Dr. Eric Kandel, whose latest book *Reductionism in Art and Brain Science*, which deals mainly with the abstract expressionists of the twentieth century, touches on visual perception and the emotional responses to abstract art. It's interesting to note that Dr. Kandel is not an art historian, but a neuroscientist.
"[Abstract expressionists] function quite a bit like scientists," says Dr. Kandel, "in that they use investigative approaches—reductionist approaches—in their art. Almost all of them begin as figurative artists, and then move toward abstract art by playing with different forms and combinations of ideas until they get what they want."

That is, abstract expressionists break down complicated images into their simplest forms: color, light, line, texture. As a brain scientist, Dr. Kandel has functioned in a similar way, by studying sea snails—a simpler life form—to better understand the human brain.So what does this have to do with the way the viewer interprets abstract art?
"We need to exercise our imagination much more with abstract art," Dr. Kandel says. "We have to fill in the details, and each one of us fills it in in a slightly different way. So people respond in a greater variety of ways to abstract art than they do to figurative art. They have to use their imagination more."

So in other words, not only does the artist use reductionism in breaking down an image, but the viewer has to employ that same reductionist approach by taking those baser elements of an abstract painting and building them back up into something he or she can understand.

**Thinking like an Artist: Translating Ideas into Form-**

1. **Honor your interests.**

"You cannot depend on your eyes when your imagination is out of focus." – Mark Twain

Be visually curious. You aren't bound by others' definitions of creativity. Art has never been denied by the constraints of materials, techniques, or technology. Making things is an everyday human impulse. Exploring the world through materials and ideas is the human quest for knowledge, and you are a part of it. Listen to your work, to your instincts, and to the world. Be a receptor for all the frequencies around you. You can lend your voice in having all your senses "a-tiptoe." You have an extraordinary, unique place in the world. Making your art lets you consider it. For me, drawing was a key that unlocked the world. It is a way of thinking and processing information that melds my brain and my hand, letting me nd profound experience in the unexpected moments of focus while making.

2. **Find your community.**

"Tell a wise person, or else keep silent, because the mass man will mock it right away." –Johann Wolfgang von Goethe.

Being an artist requires generosity of spirit, the willingness to see, hear, and feel. Art is not an ornament. It's a language. It can create a space to share and transcend boundaries. Your interests and your voice won't resonate with everyone, so invest in those who support your voice and your mission. Keep your wise counsel close. Find collaborators, mentors, and critics. Keep yourself open to those who can contribute to your life in new ways. Not every influence or meaningful critic will be someone in the arts; bring a great range of experience into your life.
Learn from and appreciate the expertise that your peers hold in a variety of fields. Art creates our community and expands our world as we explore perceptions, emotions, fantasy, and feelings. We recreate the artist's process in empathetic ways. Through expression

and exploration we collectively process our inner states. Your community is your critical audience and your support structure, but it's also filled with people you may never meet. The arts create connections and open up dialogues that we may begin but not finish ourselves. To participate in the arts is to build space for communities to grow.

3. **Be present.**

"If you ask me what I came into this life to do, I will tell you: I came to live out loud." –Émile Zola

An artist uses the material language of the world as art evolves with society. We must be the flaneurs of our time, seeing what goes unnoticed, collecting the overlooked, and provoking the future with our questions. Art and science provide us with the tools to manage and understand our surroundings, our culture. But we shouldn't forget the abilities that we have cultivated in ourselves. Our lives are overwhelmed with digital excess and technologies that can dull our senses. To see, hear, and feel our experience in the world with criticality and nuance is what makes us human. When we are drowning in material and the ephemeral content of our lives we have to ask, how do we fight back? How can we find our bearings physically in the world if we only live in the virtual? We have to find the courage to build a tangible and visceral life, not only a digital legacy. My work navigates internal and external landscapes and seeks to locate our literal and figurative bearings.

4. **Take action.**

"Vision without execution is hallucination." –Thomas Edison

Live courageously. It is now that the artist must resolve to take action. The studio, the protected sanctuary of making, must turn outward, to manifest your vision. You must join the conversation to move forward. Taking a stance, sharing your work, or even simply bringing an idea into reality can be daunting but it is necessary to the social language of art. After honing your senses and absorbing the moment, you must act.The action, even a simple pencil line, is an act of preservation, a physical record of your experience. Act, otherwise the moment is lost.

5. **Reframe Failure.**

"Success consists of going from failure to failure without loss of enthusiasm." –Winston Churchill

I challenge you not to look to your failures with disappointment, but to see both success and failure as data. This data is knowledge (in) formation. To think like an artist is to dedicate practice to remaining connected to the intuitive spirit of exploration. Fully engage in your life's work and have discipline in your mind and passion. Practicing creativity can be an exhilarating risk. As artists we have to stand at the edges of the map of our culture and push outward.
These stances on creative thinking embrace risk and an element of the unknown. They require courage and a resilient passion for looking. In our world focused on product and economy, there should be a place left for transformation, where creativity is fostered and boundaries and destinations fall away. As the chair of MoMA's committee on education, I have seen that dynamic exposure to the arts and makers can have profound effects on our community. In the future this model of creative empathy will be integral to problem solving and to building a collaborative thinking structure for developing solutions that can't be achieved alone.

**Conclusion-**

It will take more time and study to make more direct correlations between the research and teaching.
However, the good news is that the implications of creativity related research show that artistic expression
And interpretation correlate with the brain processing associated with creativity, long-term memory, concept construction, and the activation of the neural networks that are used when the brain processes information using the highest forms of cognition.

In the field of visual art it is obvious and encouraging that a disease is not an inevitably debilitating condition. On one side, an illness can seriously restrain living activities, but on the other, the creative side gives new opportunities for something that the conscious mind is not aware of. The connection between brain and music is strong and bidirectional. As Oliver Sacks, a professor of neurology and a writer who extensively studied the effect of music on human health wrote: "We turn to the music, we need it, because of its ability to move us, to induce feelings and moods, states of mind." (Sacks 2006)

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