

# STRAIGHT TALK

*with Dr. Anjan Chatterjee*



*This interview was conducted by Julia Buntaine (Editor-in-Chief, SciArt) and Richard Bright (Editor-in-Chief, Interalia), in a conversation on aesthetics and memory.*

**JB & RB:** What drew you to studying the phenomenon of aesthetic experience?

**AC:** I have always been interested in aesthetic experiences. As a boy, I sketched frequently. In college, despite majoring in philosophy and being enrolled in a pre-med curriculum, I took drawing, sculpture, and printmaking classes. Later, after the aesthetic hiatus of medical school and residency, I became obsessed with photography. To look intensely and then analytically reexamine your vision is a rewarding experience. Like many aesthetic endeavors, photography is expressive and can serve as a form of solace. The discipline of close scrutiny, thinking through composition, removal of superfluous elements while focusing on balance and form as vehicles for content, generalizes to other domains, like scientific inquiry and writing in general.

The idea of formally studying aesthetic experiences came from a barroom conversation in 1999 in Birmingham, Alabama. I had two close friends and collaborators where I worked at the University of Alabama in Birmingham—Britt Anderson, a neurologist, and Mark Mennemeier, a neuropsychologist. We often met on Friday afternoons at our favorite bar, Garages, and talked about science. I was returning to the University of Pennsylvania after having been there as a medical student. Penn recruited me as part of their initiative to start

the Center for Cognitive Neuroscience. We were all in transition. Britt posed the following question: imagine yourself ten years into the future and look back—what would you regret if you hadn't worked on it professionally? I realized that I would regret it if I had not tried to understand the biological bases for beauty and aesthetic experiences. Ten years is a reasonable period of time to develop a program of inquiry. Nothing needs to be changed right away. One can gradually move in the direction of systematically working on a problem.

**JB & RB:** In your view, what is the relationship between perception and conception?

**AC:** Perception and conception are integrally related. Recent ideas in cognitive science, such as the notion of embodied cognition, emphasize this integration. However, I do not think each can be collapsed into the other. Perceptual representations have an analog structure, which makes sense because they make contact with and extract useful information about the external world. So, the visual system from the retina to early visual cortex in the occipital lobe maintains an analog organization—for example, the upper part of what we see is represented in the lower parts of the primary visual cortex, and so on. Perceptual and motor systems are designed to be veridical about properties of the world. When you reach for a cup of coffee, you want to be sure it is actually where you think it is. Our conceptual system, narrowly conceived and most obviously indexed by language, is inherently symbolic. The neural organization of words and the combinatorial rules of syntax are not related directly to the organization of the external world. Language and conceptual systems are designed to be flexible and generative.

Since we can talk about what we see and imagine what other people tell us, these systems must obviously connect. But, how does that happen? What are the mapping principles between these different kinds of information? What are these kinds of information good for? We are developing the idea that an intermediate level of representations exists. We call them visual schemas. They have both analog and symbolic properties and are pared down forms of the kind you might see in icons or rough sketches. Essential relationships are retained but simplified and bleached of unnecessary detail. Schemas use lines, simple shapes, arrows, etc. in their depictions. We are testing the hypothesis that such representations are not simply heuristic devices; they have neural reality. Our brains are wired to process schemas that maintain a relationship to the external world by virtue of hav-



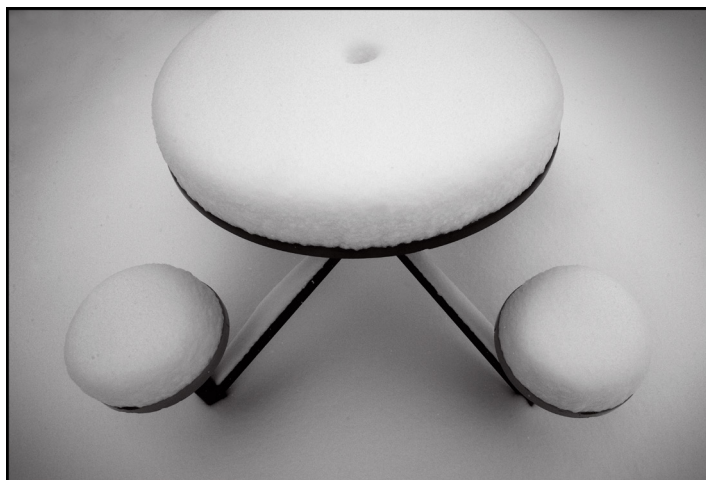
*This was the first street shot I took that I liked enough to print. To my eye, 25 years later, it still holds up.*

ing analog properties and are flexible and generative by virtue of having symbolic properties.

**JB & RB:** What kinds of transformations are taking place when ideas or data are visualized, and how is memory involved in these transformations?

**AC:** People often visualize ideas and data using schemas. These can be sketches, drawings, even figures and graphs. They vary in complexity. But they are most useful when they highlight important relational properties and discard irrelevant ones. A brain that is tuned to schematic forms means that we produce, perceive, and understand them easily. Unlike written words, which are also made up of simple lines and shapes, schemas are less subject to cultural variation and are accessible elements of thought.

Externalizing schemas, such as when we use a sketch or a graph, compensates for our brain's processing limitations. We have a limited working memory; we can only hold a few bits of information in mind at any one time. Externalizing them offloads working memory demands, and allows us to see relationships and even combinations

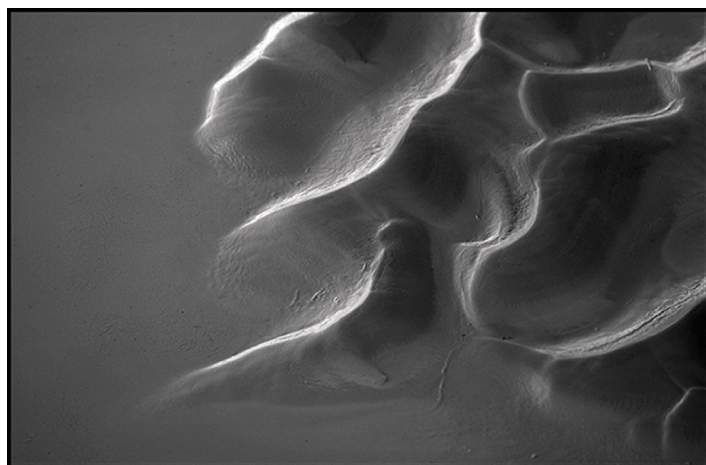


*Finding balance and simplicity. While I am not fond of snow, it does cut down on visual noise and reveals underlying structure.*

of relationships.

We have preliminary data that suggests that the right supramarginal gyrus (SMG), a part of the parietal cortex, is tuned to process simple visual schemas. This observation is intriguing because the left SMG seems tuned to phonemes—sound elements of language. Perhaps the right and left SMG specialize for visual and sound elements of visual and verbal thought respectively. Simple schemas can be concatenated. The combinatorial power of putting them together offers a chance to “see” new things. We often see new relationships by using analogy and metaphor. We also have data from my lab that implies the right rostral prefrontal cortex—one of the most recently evolved part of the brain—is involved in understanding visual analogies.

**JB & RB:** Why do you think many scientists are so strongly attracted to visual images?



*The idea that beauty can be close by is something that photography helped me appreciate. This early photograph was a pattern right at my feet.*

**AC:** Visual images help scientists clarify ideas to themselves, gain insight, and communicate information to others. A visual analogy is a comparison in which objects that appear dissimilar actually share an underlying similarity. For example, this analogy is attributed to Einstein: “You see, wire telegraph is a kind of a very, very long cat. You pull his tail in New York, and his head is meowing in Los Angeles.” Superficially, a telegraph and a cat are pretty different and yet the analogy conveys something important about the relation of a local action to a long-distance effect. Einstein used language to evoke a visual image to make his point.

Visual analogies help us solve problems by revealing hidden structural regularities despite surface differences. They allow us to apply relational knowledge from familiar situations to novel ones—such as thinking of a cat as being like a telegraph. Sometimes the most creative solutions arise from the ability to disengage from surface properties of a problem to discover hidden relations.



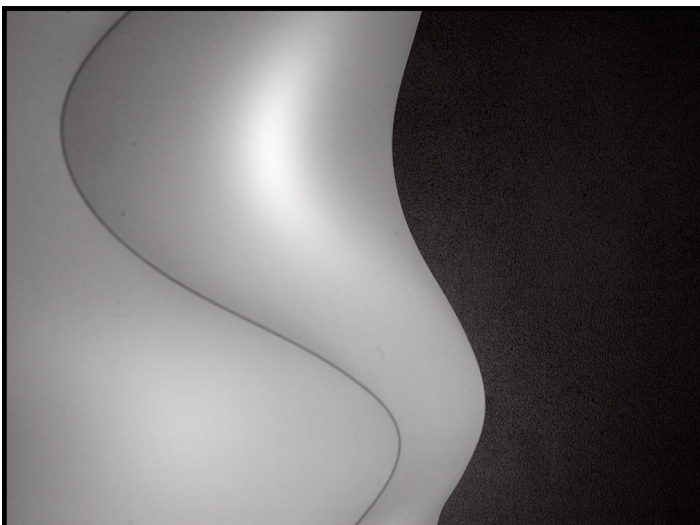


*Many regard the African savannah an archetypal landscape that most people find beautiful. I do find the land compelling.*

Old solutions can be applied to new problems and new solutions can apply to future problems.

**JB & RB:** Does our knowledge of brain structure help us understand aesthetics? How close are we to identifying the networks involved in aesthetic experience?

**AC:** We need well-articulated models and theories of what it means to have an aesthetic experience. Around 2004, I proposed an initial model approaching aesthetics from visual neuroscience. At the same time, Helmut Leder, a cognitive psychologist in Vienna, proposed a model approaching aesthetics from the psychology of abstract art. Since then, these models have been combined and refined and have evoked robust discussions about the details of such models. I do not believe we can have a meaningful understanding of the brain's response to aesthetic experiences without a rich psychological understanding and model from which one can test hypotheses. Oshin Vartanian, a cognitive neuroscientist in Toronto, and I have pared down these models into what we call the aesthetic triad. This triad involves sensory-



*This is a section of a lamp. I am convinced that beauty in everyday objects contributes to our wellbeing.*

motor systems, emotion-reward systems, and meaning-knowledge systems. We have the basic outlines of how different brain structures are engaged in these systems in the context of aesthetic experiences. But much work remains to be done.

**JB & RB:** Beauty in art vs. beauty in science: what is the common ground and what is the difference?

**AC:** Beauty in art and science evokes similar aesthetic emotions. For example, both art and science can evoke wonder and delight. Other descriptions like elegance, surprise, and even revelation are used to describe experiences in both domains. Beauty in both can be striking in a way that stops us short and elevates us beyond everyday pedestrian concerns.

There are, however, significant differences between art and science. I'm not a fan of writing that proposes that artists are really neuroscientists. I think this propo-



*Why do certain spaces evoke specific responses? The neuroscience of architecture is a field that is just starting to garner attention. For me, this space evokes movement and maybe even progress in an abstract sense. It is the Rundetaarn in Copenhagen, one of Europe's oldest functioning astronomical observatories.*

sition doesn't do justice to the unique challenges and process by which art is made and by which science is conducted. Certainly artists try to solve certain kinds of problems using trial and error. One can view this process as a kind of experimentation. However, trial and error is not experimentation in the narrow sense typical of science, where one observes the effects of manipulating specific variables under relatively controlled conditions and predicts outcomes. Scientific knowledge needs to be replicable and falsifiable. The nature of knowledge gleaned from art and science is different even if the problems they address and our emotional reactions to their respective insights might be similar.

**JB & RB:** What would you say is your favorite artwork—or one of your favorites—and why?

**AC:** That is a hard question to answer. It is like trying to choose a favorite book, or a favorite movie, or a favorite

food when there are so many great possibilities. Rather than describe a favorite, let me describe a recent aesthetic encounter that I found deeply immersive.

At the Chestnut Hill Quaker Meeting House in Philadelphia, James Turrell created an installation called *Skyspace*. Turrell works with light. The metaphor of light permeates Quaker faith and practice. On the curved ceiling of the Chestnut Hill meeting room, a rectangle is opened up to the sky. People come about a half an hour before sunset and stay past the point at which the sky goes dark. For about 45 or 50 minutes, you lie on your back in silence, staring at the ceiling/sky. On a clear night, the opening initially looks like a flat white rectangle. There are no depth cues even though you know you are gazing into unfathomable space. The white ceiling around the rectangle is bathed in a subtle light that changes gradually between white, blue, purple, and green. It has a remarkable effect that shifts the perceived



*Photographs from when I travel fix memories of that time, the location, and what I was feeling. They anchor the re-evocation of those moments. I have a clear memory walking along these dunes in Colorado.*

hues of the rectangle, which itself is objectively changing as day gives way to night. For me, gazing at the rectangle was reminiscent of the best experiences of gazing at a Malevich or Rothko painting, except that the open sky forms the canvas. In museums, most people spend less than 20 seconds in front of a painting they like. By contrast, there is a profound stillness to lying down and staring at a rectangle for 50 minutes. In that stillness, one senses the flatness of our view in the presence of an immense space, the fragility of our perception, and the inexorable but ever so gradual change around us. Most of us do not have enough stillness in our lives.

**JB & RB:** What is the end-goal, functional application of neuroaesthetics research? Are we working towards an art-producing robot?

**AC:** Neuroaesthetics has many functional applications. Obvious ones are the uses of art therapy to leverage aesthetic experiences to help people with brain damage



*This picture was taken on the streets of Santa Marta, Colombia. I distinctly remember the confident swagger of these kids.*

such as dementing illnesses or PTSD. The neuroaesthetics of natural landscapes and their relationship to built environments and architecture is a newly emerging area that could prove to be extremely valuable. What about the physical environment that we construct around ourselves affects our wellbeing and invites us to flourish? More generally, design of everyday objects with which we interact, including computer interfaces, is a direct application of aesthetics. I suspect aesthetics could probably be used profitably in education as well to help developing minds engage with the topics of study.

Ultimately, and perhaps ironically, a critically important feature of aesthetics is its lack of functionality. The core aesthetic experience is self-contained. We live in a world dominated by productivity and accomplishments as markers of success. Many children in the U.S. do not have much free time for unstructured play where their imaginations are free to wander. The focus on external rewards can keep people from developing an understanding of what it is they like and want, as well as the intrinsic value of experiences. Aesthetic encounters, like Turrell's *Skyspace*, slow us down and immerse us. They are an important way to experience and nurture intrinsic value through stillness.



*A picture taken on the transatlantic ship SS America when my family was emigrating from India to the U.S. It would have been 1960. Photographer unknown. All images courtesy of Anjan Chatterjee.*