

Reductionism in Art and Brain Science: Bridging the Two Cultures

by Eric R. Kandel

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Reductionism in Art and Brain Science: Bridging the Two Cultures by Eric Kandel, like his study *The Age of Insight* [1], builds on earlier efforts to couple science and art, particularly those of Alois Riegl (1858-1905), Ernst Kris (1900-1957), and Ernst Gombrich (1909-2001). These three men, he tells us, endeavored to establish art history as a scientific discipline by grounding it in psychological principles. Riegl emphasized the "beholder's involvement, stating that art includes the perceptual and emotional involvement of the viewer. Kris studied ambiguity in visual perception, concluding that every powerful image is inherently ambiguous because it arises from experiences and conflicts in the artist's life. Gombrich extended Kris' ideas to include the inverse optics problem: how our brain takes the incomplete information about the outside world that it receives from our eyes and makes it complete. This is a problem that arises because the brain reconstructs the images we see. It should be noted that Gombrich's positioning in his well known *Art and Illusion* [2] is, like Kandel's, more concerned with beholders than artists or the community.

Kandel defines art as unconscious and subjective and endeavors to present a reductive and objective rendering of it. Thus, he poses questions like: "Can any aspect of art, which is a creative and subjective experience, be studied objectively?" (p. 17). Within this confine he assumes that, "although the reductionist approaches of scientists and artists are not identical in their aims - scientists use reductionism to solve a complex problem, and artists use it to elicit a new perceptual and emotional response in the beholder - they are analogous" (p. 6). The artworks narrative is largely focused on the viewer's brain operations in relation to sensation and perception, although memory and learning are discussed as well. His presentation centers on artists who employ simple design elements such as form, line, color, and light in their compositions. His claim is that these kinds of works allow the beholder to reductively understand how the brain responds to art because "rather than depicting an object or image in all its richness, they often deconstructed it, focusing on one or, at most, a few components and finding richness by exploring those components in a new way" (p.9). (He does step out of this box in his presentation of Chuck Close, as I will explain shortly.) As the author correctly notes, many artists (*e.g.* Kandinsky) have explained their art using reductionistic sounding statements.

Clearly, Kandel read extensively in developing this volume, and sections outlining historical psychological studies and contemporary neuroscientific research offer informative background as he interprets selected artworks; but the cohort is quite limited. The argument is largely focused on the Abstract Expressionists of the New York School and the color-field painters (Willem de Kooning, Jackson Pollock, Mark Rothko, Morris Louis, and others) who worked in America in the mid-twentieth century and includes a few artists who worked after them (*e.g.* Alex Katz, Andy Warhol, Dan Flavin, James Turrell, Chuck Close, and others). *Leonardo* readers will quickly discover vast lacunas exist in terms of his assumptions about what art is and the range of media artists employ. Similarly, the author seems unaware of the kinds of collaborative projects that often drive art and science in tandem.

While the bulk of Kandel's art analyses relies on the writings of contemporaneous mid-twentieth century art critics and historians, an intriguing feature is that Clement Greenberg's theoretical formulations most closely align with Kandel's view, although it should be noted Greenberg emphasized form, gestural painting, and deeper truths, and Kandel relies more on Riegl/Kris/Gombrich with his "beholder" and ambiguity emphasis. If Greenberg seems like a strange advocate for a science of art, one need only recall this art critic presented the artist's studio as if it functioned like a scientific laboratory: "It's as though they undertook to do this as in a laboratory, spelling out everything the way it's supposed to be done in a laboratory (though nothing could have been further from their conscious minds" [3]. As noted, Kandel claims these artists used a reductive approach that reveals their subjective and unconscious. Yet, he also claims that, "By reducing images to form, line, color, or light, abstract art relies more heavily on top-down processing - and therefore our emotions, our imagination, and our creativity" (p. 58). If the goal of

reductionism is to reduce things to the simpler, bottom-up elements, Kandel's top-down explanation of how these artists accomplished their goals, to my mind, only serves to conflate things. This kind of interpretation also reinforces the mythologies and religious overtones that have often plagued art historical commentary. In other words, Kandel's proposal, like Greenberg's ideas, rest upon an "unconscious" element, even as the scientist adds a wealth of scientific detail about how the observer's brain perceives elements like shapes and color to the mix, as the following summary from [Reductionism](#) shows:

"Each work is highly ambiguous, as great poetry is, and each focuses our attention on the work itself, without reference to people or objects in the external environment. As a result, we project our own impressions, memories, aspirations, and feelings onto the canvas. It is like a perfect psychoanalytical transference, where the patient imposes upon the therapist a replay of experiences with parents and other important individuals, or like the repetition of a word or a tone in Buddhist meditation." (p. 178)

Given Kandel's claim that abstract art offers entry into the imagination, unconscious, and subjective states, the question of how we evaluate his scientific proposal is front and center. In other words, can we test (or falsify) Kandel's claim that this small sample offers entry into reductively thinking about art so as to see it more in terms of science? In his autobiography Kandel quotes John Eccles to emphasize the importance of Karl Popper's ideas about falsification to the scientific process. I would think this idea would equally apply to scientific proposals that aim to establish a reductive approach to art. He writes:

"I learned from Popper what for me is the essence of scientific investigation - how to be speculative and imaginative in the creation of hypotheses, and then challenge them with the utmost rigor, both by utilizing all existing knowledge and by mounting the most searching experimental attacks. I learned from him even to rejoice in the refutation of a cherished hypothesis, because that, too, is a scientific achievement and because much has been learned by refutation." [4]

Ironically, although Kandel does not mention it, the very cast of art characters he includes in this volume asked whether falsification pertains to abstract art within the context of their time, the mid-twentieth century Zeitgeist in which scientific thinking was ascendant. At that time Gombrich (a close friend of Karl Popper's) and Greenberg brought opposing views to the table, conducting their dispute within the contours of the positivism and falsification debates [5]. Unlike falsification, which advocates for an ongoing questioning of all hypotheses, positivism holds that every rationally justifiable assertion can be scientifically verified or is capable of logical or mathematical proof. The difference between the two is a matter of emphasis, one that speaks to how falsification is positioned and the difference between falsification and verification. It is easier to grasp contextually.

Essentially two issues divided Greenberg and Gombrich. The first was the question: what should a science of art include? The second was whether a theory of art could fulfill Popper's falsification criteria. To oversimplify, Gombrich claimed we cannot falsify abstract art because there is no external correlate through which we can evaluate its credibility. This is because the products deviate from the kinds of objects that comprise our communal experience. Clement Greenberg argued exactly the opposite. For him the validity of the abstract work came about precisely because the art objects were both material products and nonobjective. The lack of an external correlate for evaluation was thus presented as a positive rather than a negative feature since known elements would not distract the viewer from engaging with precisely what the artist presented. This is not a falsifiable position methodologically because it rests on the logical proposition that essentially claims the artist is revealing deeper or *a priori* truths. Together, these two positions raise the question of how does one disprove an ambiguous, subjective, or *a priori* truth - and who decides?

Popper's falsification theory assumes it takes only a single counterinstance to falsify a statement. So, if one sees a black swan, this falsifies a statement such as "All swans are white." In terms of what art is or who decides what art is, social context and society are often the arbiter of an artist's statements. As it turned out, and to grossly oversimplify, Greenberg's actions raised concerns about his evaluations of art and how we evaluate what comes out of the artist's laboratory (the studio). Essentially, this critic lost a great deal of credibility and raised questions about critical evaluations of what an artist does after it came out that he had mutilated artworks in his care to bring them closer to his aesthetic preferences [6]. This was also one reason that styles outside of the abstract genre once again became more acceptable to the art elites in the late twentieth century. Indeed, the toppling of Greenberg's authority played a role in encouraging the pluralism of that era.

Greenberg's loss of stature as a viable and believable aesthetic arbiter additionally underscores that Popper introduced the falsification process precisely because there is no way to "prove" how individual and cultural biases enter scientific analyses and/or the so-called truths people attribute to or align with "higher," "deeper," or "spiritual" intuitions. I would add that this is particularly true when the subject is art, which includes artists with various goals who express themselves in various ways. Reductive studies of learning, memory, sensation and perception, while valuable on their own terms, do not seem robust enough to explain art's complexity. In other words, why are people - even people within the small art community cohort - of many minds even when it comes to evaluating the small sample of work Kandel presents?

This brings me to creativity. By casting art in terms of a "beholder's" response to objects and how these objects somehow expose the nature of self, Kandel significantly and repeatedly conflates art objects with the many nuances of artistic creativity. In doing so he surprisingly seems to lose sight of the creative aspect of art, even as creativity is so eloquently elucidated in his autobiography, *In Search of Memory*. In *Search* Kandel writes about his early interest in psychoanalysis and how he shifted his focus to the biology of the brain, which eventually led him to biology of mind. A key event was a medical school exercise:

"I had greatly enjoyed the course on the anatomy of the brain that I had taken during my second year in medical school. Louis Hausman, who taught the course, had each of us build out of colored clays a large-scale model that was four times the size of the human brain. As my classmates later described it in our yearbook, "The clay model stirred the dormant germ of creativity, and even the least sensitive among us begat a multihued brain." [7]

According to Kandel, this model gave him his first three-dimensional view of how the spinal cord and the brain come together to make up the central nervous system. He found, "[i]t was hard to look at the brain, even a clay model of it, without wondering where Freud's ego, id, and superego were located" [8]. After explaining his urge to locate these areas to a professor, Kandel was told that probing the brain one cell at a time was a better strategy. Over the course of his life Kandel's research led him from cells to molecules and genes before neural science offered a means to experimentally return to the biology of mind questions that so intrigued him when he first discovered Freud's work. As an Austrian-American neuropsychiatrist, Kandel's (b. 1929) studies have made a tremendous mark on science. He won the 2000 Nobel Prize in Physiology or Medicine for his research on the physiological basis of memory storage in neurons. His autobiography delineates a creative individual who brings a great deal of passion to his work.

Kandel's description of how a hands-on anatomical project stirred the medical students to think creatively brings to mind the wax models of artist/anatomist Anna Morandi Manzolini (1716-1774). She worked in Bologna, a community where men and women, artists and scientists, engaged one another, much like they did in the *Fin-de-siècle* Vienna that Kandel described in [The Age of Insight](#) or as we do in the *Leonardo* community of today. Trained as a sculptor, Morandi went on to make renowned objects that

were collected throughout Europe during her lifetime due to the artistry she brought to her studies of the body. For example, her exquisite self-portrait with a brain presents her dissecting the organ in period clothing and jewelry, even as it fails to show that her nimble fingers led to original discoveries. [Her piece does show](#) her hands in a revelatory posture as if to suggest she is explaining the brain she has just dissected, however [9]. This piece also reminds us that, even when brain studies were limited to the gross cortical anatomy, cross-disciplinary projects were a part of our cultural evolution. Indeed, Luigi Galvani, an early contributor to our understanding of the brain and the father of electrophysiology, held Morandi's art in high regard. For him, her works did not bring to mind the putrid smells that accompanied dissections. Rather, as Galvani wrote, these elegant, beautiful models would please viewers so much that they would be drawn to undertake the study of anatomy.

[Reductionism in Art and Brain Science](#) does not capture this kind of interface or how sketching out an idea or making a model might help an artist begin to conceptualize compelling directions for a work as she develops it, much as the model of the brain Kandel built in medical school helped him ponder possibilities - bootstrapping, if you will. Nor does the book capture how one's personal context and the community at large aid (or hinder) in fitting an artist's presentation together.

Because disciplinary interweaving exists today, as it has throughout history, the popularity of the Two Cultures meme has always puzzled me [10]. It was particularly puzzling to find it in the title of Kandel's [Reductionism in Art and Brain Science: Bridging the Two Cultures](#). Yet, after reading this volume, it made more sense because Kandel's creative mind and personality, so evident in his autobiography, seemed somewhat remote in this recent book. Both books are engaging, clear, concise, easy to read, and well written. Yet, while his autobiography suggests a man who easily bridges art and science - he is an art collector and loves music - he comes across more as a science educator in [Reductionism](#). This makes the book a valuable tool for those who want to learn more about brain operations, particularly visual perception, but it is unclear what role he thinks art and artists play in discussions combining art and science - other than providing products scientists can explain and interpret to a limited degree. After reading the volume I was unable to conceptualize why those of us on the art side of things would want to reduce art to a reductionistic methodology that largely treats art as objects that others "behold." In other words, his approach largely excludes the nuances of artistic praxis, the variety of media artists use, the collaborative projects that often accompany creative insights as paradigms change, the range of artistic styles, how tastes change, and our differing experiential preferences when we engage with art. Of course, and perhaps needless to say, many on the art side of things also do not see art as a problem we need to solve or resolve.

While it is perhaps an impossible task to speak to the uniqueness of each individual, the strongest section of the book, on Chuck Close, does not rely on metaphorical or historical canards. Rather, Kandel looks at how Close came to do the kind of work he does. A dyslexic who suffers from the neurological condition of prosopagnosia (face blindness), this artist can identify a face as a face but he cannot look at someone's face and recognize that person. Kandel discusses the role of the brain deficit in Close's art and thus we see how traits specific to this artist's person have translated into his creative projects over the years. He developed a style that centers on the elaboration of details in faces. Although unmentioned in the book, when Close decided to paint faces early in his career it was a radical departure from Abstract Expressionist tenets because it defied Greenberg's pronouncement that portraiture was no longer a legitimate subject for painting.

I would have liked more examples like Close and more engagement with open-ended questions. While not integrated into the art analyses, Kandel does mention recent research that offers avenues for positioning art and the brain in novel ways. Scientific work related to brain modification during our lives is an intriguing area precisely because it lends itself to the range of art people produce and the plurality within the hard to categorize projects we call art. Similarly studies showing that the architecture of each individual's brain is unique - because each of us has a different life experience - hold promise. Moreover, because artists produce throughout their lives biological changes within them are mirrored in their oeuvre's evolution over

the course of their lives. Although he mentions studies showing the brain's potential for modification with age, for example, he did not pursue this line of thinking.

Finally, how an individual's context influences her views is evident even within this review. I became interested in art and the brain during the Decade of the Brain, the 1990s. An artist myself, and a practitioner of the kind of abstract work Kandel celebrates in *Reductionism in Art and Science*, my turn to the brain came about because both art history and the same psychology of art Kandel references as his starting point for this study failed to address something I thought was important and was unable to state. In the 1990s many art historians were developing broader, contextual, and more pluralistic approaches. Those within the cross-disciplinary cognitive neuroscience purview, by contrast, were simply perplexed that an artist was interested in the brain. Indeed, I quickly learned that the easiest way to end a conversation with a cognitive neuroscientist then was to say that I was interested in *art* and the brain. Before turning away the person would usually say something to the effect that art is not a valid component of the biology of mind approach. If there was not total disdain, the scientist or philosopher might add that this is because art is about emotions and deeper truths. So, on some level, reading this book was like watching my entire life pass before my eyes. Kandel's *Reductionism* is now one of many recent books demonstrating that art is finally on the map of cognitive neuroscience. I applaud this even as I find many of the volumes remind me of how difficult it is to work in this area. Suffice it to say that as an artist I, strangely, found the narrative Kandel presented in his autobiography more in line with my thinking about who artists are and what I, and artists I know, do - even as art was not the subject of that earlier book.

So, in summary, those who are want to learn more about brain operations, particularly visual perception, will find a great deal of excellent material in *Reductionism in Art and Science*. As for art *per se*, I think reader responses will vary based on who they are and what their own vision of art is. Needless to say, building bridges that aid communication is always a worthwhile endeavor. I applaud his effort to reach out.

References

[1] Kandel, Eric R. 2012. *The Age of Insight: The Quest to Understand the Unconscious in Art, Mind, and Brain: From Vienna 1900 To The Present*. New York: Random House.

[2] Gombrich, E.H. 2000. *Art and Illusion: A Study in the Psychology of Pictorial Representation*. Princeton, NJ: Princeton University Press.

[3] Greenberg, Clement. 1999. *Homemade Esthetics: Observations on Art and Taste*. New York: Oxford University Press. p. 36.

[4] Kandel, Eric R. 2006. *In Search of Memory: The Emergence of a New Science of Mind*. New York: W. W. Norton & Company, p. 97.

[5] A good source for this debate is Jones, Caroline A. 2005. *Eyesight Alone: Clement Greenberg's Modernism and the Bureaucratization of the Senses*. Chicago: University of Chicago Press.

[6] Krauss, Rosalind. 1983. "Changing the Work of David Smith." *Art Journal* 43 (1):89-95. doi: [10.1080/00043249.1983.10792208](https://doi.org/10.1080/00043249.1983.10792208).

[7] [4], p.44

[8] [4], p.55

[9] An image is available at <https://goo.gl/cFtxT1>.

[10] Ione, Amy. 2016. *Art and the Brain: Plasticity, Embodiment, and the Unclosed Circle*. Amsterdam: Rodopi Brill.

*Reviewed by Amy Ione (ione [at] diatrope [dot] com)
Director, The Diatrope Institute*

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