Neuroaesthetics: The State of the Domain in 2017

Aaron Kozbelt

Abstract

In this article, I assess the current state of neuroaesthetics by reviewing 10 recent books on neuroscientific and evolutionary aspects of aesthetic cognition. These books largely continue the main thrust of this genre since its inception. Virtually all are insightful and thought-provoking, though their individual strengths vary. Among them, Shimamura and Palmer's edited book, *Aesthetic Science*, provides the most useful and balanced interdisciplinary framework, making philosophy and psychology equal partners with neuroscience. This pluralistic mode, dethroning neuroscience from its usual hegemony, seems best poised to address heretofore neglected issues in neuroaesthetics research. I address several dichotomous tensions—high versus low art, the drive for creative innovation versus evolutionarily canalized aesthetic biases, and explicit versus implicit aspects of aesthetic cognition—to identify promising future research directions, which can best be fulfilled though interdisciplinary cooperation and debate, with a continued emphasis on evolutionary theory.

Keywords: neuroaesthetics, evolution, neuroscience, aesthetic cognition, art appreciation, aesthetic experience, creativity, two cultures

BOOKS UNDER REVIEW

Chatterjee, Anjan. 2014. *The Aesthetic Brain: How We Evolved to Desire Beauty and Enjoy Art*. New York: Oxford University Press. xxiii, 217 pages. Paperback $19.95.

Huston, Joseph P., Marcos Nadal, Francisco Mora, Luigi F. Agnati, and Camilo J. Cela-Conde, eds. 2015. *Art, Aesthetics, and the Brain*. New York: Oxford University Press. vii, 545 pages. Hardcover $159.50.

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. 636 pages. Hardcover $50.00.

Kandel, Eric R. 2016. *Reductionism in Art and Brain Science.* New York: Columbia University Press. 226 pages. Hardcover $29.95.

Lauring, Jon O., ed. 2014. *An Introduction to Neuroaesthetics: The Neuroscientific Approach to Aesthetic Experience, Artistic Creativity, and Arts Appreciation.* Copenhagen: Museum Tusculanum Press. ix, 425 pages. Paperback $50.00.

Orians, Gordon H. 2014. *Snakes, Sunrises, and Shakespeare*. Chicago: University of Chicago Press. 221 pages. Paperback $17.00.

Rothenberg, David. 2011. *Survival of the Beautiful: Art, Science, and Evolution*. New York: Bloomsbury. 311 pages. Paperback $19.00.

Shimamura, Arthur P. 2013. *Experiencing Art: In the Brain of the Beholder*. New York: Oxford University Press. 280 pages. Paperback $56.00.

Shimamura, Arthur P., and Stephen E. Palmer, eds. 2012. *Aesthetic Science: Connecting Minds, Brains, and Experience*. New York: Oxford University Press. 408 pages. Paperback $47.95.

Starr, G. Gabrielle. 2013. *Feeling Beauty: The Neuroscience of Aesthetic Experience*. Cambridge, MA: MIT Press. xvi, 259 pages. Hardcover $30.00.

It is 2017, and neuroaesthetics is all grown up—at least chronologically. Neuroaesthetics, the interdisciplinary study of the neural processes underlying aesthetic behavior, decisively arrived on the scene in 1999 via two seminal publications: Semir Zeki's book, *Inner Vision: An Exploration of Art and the Brain* (Zeki 1999), and V. S. Ramachandran and William Hirstein's article, "The Science of Art" in the

Journal of Consciousness Studies (Ramachandran and Hirstein 1999). Now that neuroaesthetics has reached the legal age of adulthood, it is an opportune time to evaluate the state of the domain. Has neuroaesthetics matured? Has it lived up to its early promise? Has it decided what it wants to be, or at least what it should major in? Will it be able to make it on its own?

In important ways, neuroaesthetics has remained true to its roots. As Zeki, its founding father, argued, "Art is a human activity and like all human activities … depends upon, and obeys, the laws of the brain" (Zeki 2009). Neuroaesthetics researchers have retained this reductionist spirit to a striking degree. As neuroimaging technologies continue to advance, efforts to capitalize on this sophistication proceed apace, and established methodologies are applied to subtler questions and in a greater variety of aesthetic domains. Throughout this development, researchers have maintained a focus on localization of neural function as the royal road to understanding the biological underpinnings of aesthetic experience. At the same time, neighboring disciplines, including philosophical aesthetics, scientific psychology, evolutionary biology, and art history, continue to make contributions, even though sometimes this seems like shouting from the peanut gallery, if not quite voices crying in the wilderness.

What are the goals of neuroaesthetics, and how should those goals be realized? At its most outrageously ambitious, a reductionist, neutrally informed framework would constitute a "theory of everything" about human aesthetic experience, judgment, and creativity. Like an adaptationist program in evolutionary biology, in which evolved structures and behaviors are considered as adaptations until proven otherwise—*pace* evolutionary spandrels (Gould and Lewontin 1979)—reductionism may prove a very useful strategy in the near term. This may be especially true for neuroaesthetics at this moment—nascent, but rapidly developing and potentially approaching "a historical inflection point . . . poised to enter the mainstream of scientific inquiry" (Chatterjee and Vartanian 2014, 370).

More realistically, probably the brain is too complex, and art is too complex and too socioculturally embedded, to surrender their respective glories so abjectly to hard-nosed neurodeterministic reductionism. Still, articulating the relation between neuroscience, widely regarded as *the* prime mover in neuroaesthetics, and adjacent domains as inquiry moves forward has been a long-standing point of contention—one not yet resolved. It is also an open question as to whether such a fully consilient resolution (*à la* Wilson 1998), particularly if it is premature, is even desirable. Are there benefits to forestalling vigorous, multidisciplinary debate in the interest of establishing a universal paradigm? (I think not.) Is such a paradigm even possible in an inherently interdisciplinary endeavor? (I am not sure that it is.) Is neuroaesthetics completely ready for consolidation as a freestanding domain? (I don't think anyone knows for sure.) To evaluate the status of neuroaesthetic inquiry, it is worth examining the kinds of contributions made by its constituent domains, to assess their relative strengths and limitations, and to pinpoint issues that have thus far either been neglected or that have not yielded to researchers' efforts.

The goal of this article is to explore these themes by reviewing several book-length treatments of neuroaesthetics and evolutionary themes relevant to neuroaesthetics that have been published in the last five years or so. After considering individual books in the next section, I end by discussing some salient broader multidisciplinary concerns, which neuroaesthetics researchers of all stripes will need to address in some form as the enterprise moves forward.

THE BOOKS

Since Zeki's *Inner Vision* in 1999, a steady stream of books on neuroaesthetics, evolutionary aesthetics, and the psychology of art and

creativity has been published. The latest crop—that is, additions to the literature from the last five or so years—show a good deal of continuity with earlier releases. The most prominent features of books in this genre have been consistent from the beginning. They include the following: a mandatory discussion of neuroimaging and brain function, preferably with high-quality images of brain scans; a default emphasis on visual art as *the* paradigmatic aesthetic domain (unless a book is specifically devoted to another domain, like music); an overt sentiment that artistic creators should be regarded as intuitive neuroscientists whose work reveals fundamental aspects of neural processing and brain organization; and some discussion of evolutionary theory as it pertains to aesthetic questions. Historically, this last point has been optional, but, fortunately, evolutionary themes are better represented among more recent publications.

The books I review here share and divide many strengths among them. Regarding the single-author volumes, that by Shimamura is the most accessible; Starr, the most humanistic and elegantly written; Chatterjee and Kandel, the most synthetic; Orians, the most grounded in a specific evolutionary theory; Rothenberg, the most idiosyncratic (a compliment, by the way). Of the edited volumes, that by Huston et al. is the most comprehensive; Lauring best addresses unjustly neglected aesthetic domains; Shimamura and Palmer propose the most useful intellectual framework for future work. I now elaborate.

Arthur P. Shimamura's *Experiencing Art* is a user-friendly introduction to the mainstream contemporary psychology of art. Neuroscience themes are present, but they do not predominate. In many ways, it is a direct descendant of Robert Solso's well-regarded *Cognition and the Visual Arts* (Solso 1994; see also Solso 2003)—a parallel made explicit in the preface. Shimamura's text is more wide-ranging than Solso's, but it is straightforwardly organized along Shimamura's I-SKE model of art experience. This consists of an artist's *intention* (I) to offer an artwork for aesthetic evaluation and the beholder's response, in terms of *sensations*, *knowledge*, and *emotions* (SKE). There is not much content that is new or revelatory, in keeping with its mostly agenda-free expository tone. The book is copiously illustrated, mostly with artworks spanning many cultures and epochs, plus some brain images and experiment stimuli. It also has clever, cutesy chapter and section titles, making it an engaging undergraduate text for such courses as Psychology of Art, or Art and Visual Perception, as Shimamura himself has taught.

G. Gabrielle Starr's *Feeling Beauty* is at once the most focused scientifically and the most expansive in terms of traditional humanities. The scientific side is almost exclusively an extended discussion, threaded throughout the book, of a single paper by Starr and colleagues (Vessel, Starr, and Rubin 2012). Staking a book-length argument on one short article is risky, but in this case the article is very wisely chosen: in my view, it ranks as the single most interesting empirical contribution to neuroaesthetics in recent years. Specifically, it presents neuroimaging evidence that only intense levels of aesthetic experience (and not milder levels) are associated with activation of the default mode network. The default mode network is a set of interconnected brain areas that are generally active in states of unfocused but wakeful rest (such as daydreaming and mind-wandering) but whose activation decreases with external stimulation—like laboratory tasks that require participants to pay attention. Surprisingly, parts of the default mode network can reemerge as activated in the lab, when participants report the most intense levels of aesthetic experience. This suggests that powerful aesthetic experiences induce the brain to integrate external perceptions with inner qualities, including one's sense of self.

Like many data-based conclusions in the neuroaesthetics literature, the association between the default mode network and intense aesthetic experience may seem self-evident in hindsight. But a focus on the deeper implications of

meaningful engagement with artworks, rather than simplistic conclusions based on forced-choice preference or Likert-scale judgments by inexpert, unmotivated undergraduates, seems a very promising direction. Starr engages head-on the humanist tradition of interpretive meaning-making as fundamental to our aesthetic experience, examining the "sister arts" of literature, music, and visual art. She provides lucid interpretations of poetry by Keats and Ovid (far more subtle and nuanced than I could ever muster), music via Beethoven and bluegrass, and artwork by Bernini and van Gogh. Starr's multifaceted treatment revolves almost entirely around the construct of aesthetic experience, and other scholars—if they can manage it—would do well to follow her path in developing such a framework vis-à-vis other aspects beyond aesthetic experience, such as aesthetic judgment or the creative process.

Anjan Chatterjee's *The Aesthetic Brain* is also written with enviable clarity. It is remarkably self-effacing; despite Chatterjee's many contributions to neuroaesthetics, only 2 of the book's 242 citations are of his own work. Built of short sentences with a very high idea density, his argument unfolds incrementally, only arriving at an overt discussion of art in the last third of the book. As such, evolutionary themes are much more prominent here, and Chatterjee's emphasis on the perception of beauty as grounded in naturalistic situations—like mate, habitat, and food selection, which extend deep into our evolutionary past—is well taken. His arguments about art are wide-ranging, well informed, and stimulating, but he never delves into depth of interpretation of individual works, as Starr does. Chatterjee's argument culminates in a discussion of work by noted biological anthropologist Terrence Deacon on the evolution of birdsong among domestic Bengalese finches, where relaxed evolutionary constraints have promoted greater song variety (Deacon 2010). Chatterjee applies this pattern of constraints to human culture and creativity, a rich analogy worthy of meditation. If I were to choose a book from among those reviewed here for a graduate course I coteach, titled Neuroscience, Evolution, and Creativity, I would probably go with Chatterjee's extremely impressive volume.

Just as grounded in biological and evolutionary themes is Gordon H. Orians's *Snakes, Sunrises, and Shakespeare*. Orians is a major proponent of the so-called savannah hypothesis, whereby many basic aspects of our humanity—including our fears (such as snakes) and aesthetic preferences (such as particular kinds of landscapes)—remain rooted in the features of our ancestral African environment. Orians provocatively terms this modern-day residue "the ghosts of the savannah." The book has considerable substance, with Orians bringing an unusually specific set of predictions and methods to these issues—for instance, in carefully measuring various features of different types of trees and relating these to evolutionarily canalized aesthetic judgments. Having read this book, I now think about trees in a completely different way (high praise). Disappointingly, however, Orians outdoes even Chatterjee in deferring an overt treatment of high-level human art: despite brief discussions of musical universals, decorative tile patterns, and garden design, "Shakespeare" is literally never mentioned apart from the book's cover! This disconnect reinforces a lacuna between basic biological predispositions and how they ultimately play out in modes of art far removed from our evolutionary origins—a theme developed below.

Eric R. Kandel, who won the 2000 Nobel Prize in Medicine and Physiology for his seminal work on the neural mechanisms of learning and memory, has written two recent books relevant to neuroaesthetics. One is 2012's *The Age of Insight*, a magisterial exploration of the long reach of intellectual and artistic innovations in *fin de siècle* Vienna, which covers more than a century of cognitive and neuroscience research. Its 2016 successor, *Reductionism in Art and Brain Science*, rehashes much of the same neuroscience but applies it to the question of abstraction throughout the full sweep of

twentieth-century art. Both books are lavishly produced and address a range of deep questions fundamental to neuroaesthetics.

In some ways, *The Age of Insight* is Kandel's paean to his native city of Vienna, from which he fled after the Nazi *Anschluss*. Despite being longer than any other book reviewed here, it maintains a thematic focus on psychological and neuroscience understanding of portraiture by Viennese expressionist artists Gustav Klimt, Egon Schiele, and Oskar Kokoschka. The main thread of the argument is peppered with elegant asides on various topics in scientific, artistic, and cultural history. Kandel's admirable control over his material acts to contain and streamline his otherwise unwieldy topics. Conveniently, his approach, emphasizing hands and faces in figurative portraits, maps remarkably well on to embodiment and neuroscience *terra cognita*. Certain themes remain underdeveloped, such as evolutionary mechanisms that gave rise to the artistic and neuroscience phenomena under discussion, the nature of aesthetic emotions, and a richer treatment of the creative process; however, these criticisms apply to many books, and they do not significantly detract from this virtuoso performance.

Kandel's more recent volume, *Reductionism in Art and Brain Science*, is considerably leaner and more focused. This befits its emphasis on abstraction as a species of reductionism, whereby images are pared down to essential elements of form, line, color, or light. Here Kandel argues for the theme of reductionism as a means of closing the chasm between C. P. Snow's famous "two cultures" of the humanities and sciences (Snow 1959), an oft-cited goal in interdisciplinary enterprises. There is relatively little neuroscience here, with more space devoted to abstract artworks spanning the entire twentieth century. These include the paintings of Wassily Kandinsky, Piet Mondrian, and Arnold Schoenberg (better known as the creator of musical serialism), through abstract expressionists like Willem de Kooning, Jackson Pollock, Mark Rothko, and Morris Louis, and more recent figures like Andy Warhol, Alex Katz, Chuck Close, Dan Flavin, James Turrell, and Fred Sandback. The sheer number of individuals under discussion means that the book necessarily moves very quickly, with each artist receiving only a few pages. However apt for a book on reductionism, the extreme concision of the text may be off-putting: 14 generously spaced chapters fit into less than 190 pages, which also include 102 illustrations and several blank pages between sections. However, Kandel's points are insightful and well taken, and the roster of artists is a most refreshing change from the tired examples (the *Mona Lisa*, Duchamp's urinal) characteristic of much earlier and current writing on neuroaesthetics. This broadening of concern for nontraditional forms and styles of visual art is a theme discussed below.

Nontraditional art (and science) is also emphasized in David Rothenberg's *Survival of the Beautiful.* This book is a wild ride, to say the least. Birds—their bowers, songs, and plumage—are the focus of its first hundred pages. In fairness, birds have played an unusually prominent role in discussions of biologically grounded aesthetics, from peacock tails as an emblem of sexual selection (Darwin 1871; Miller 2000), to herring gulls as a model of peak shift (Ramachandran and Seckel 2012), to the creative evolution of Bengalese finch songs (Deacon 2010; Chatterjee 2014). But Rothenberg avoids these facile parallels, interpreting avian aesthetics idiosyncratically. Detailing extensive conversations with eminent Yale ornithologist Richard Prum, he attempts to understand the nature of beauty in the biological world, frequently arguing against orthodox biological opinion. This includes the famed "handicap principle" as a reframing of Darwinian sexual selection (Zahavi 1997), which Rothenberg would recast as the selection of beauty. He is anxious to justify the ways of art to science and to document substantive contributions to real science that have been made by art, rather than relying on simplistic post hoc comparisons between the two.

Like Kandel and Chatterjee, Rothenberg is admirably open to a diversity of aesthetic productions and experiences. As the book proceeds, there are lengthy discussions of animal and human camouflage, scientific illustration, participatory art experiences, elephant art, phosphenes, and much more. This is not a book for everybody—Rothenberg indulges in a fair amount of autobiography and opining, ending the volume in a passage of almost Paterian ecstasy. But his passion is hard to fault. Moreover, unorthodox contributions should be especially welcome when a gathering critical mass of findings and theory threaten to ossify the paradigm of the domain, even as it is still emerging. I don't agree with all of Rothenberg's conclusions, but the number of dog-eared pages in my copy testify to the thought-provoking quality of his writing.

Besides these single-author books, three recent edited volumes also merit discussion. The heftiest is a 25-chapter collection edited by Joseph P. Huston, Marcos Nadal, Francisco Mora, Luigi F. Agnati, and Camilo J. Cela-Conde, entitled *Art, Aesthetics, and the Brain*. This book is unmatched in its range of coverage, with multichapter sections on visual art, dance, and music; there are also broader interdisciplinary treatments of foundational issues, neuropsychology, evolution, and integrative approaches. Individual chapters range widely in their level of specificity, sometimes adopting quite narrow foci. Neuroscience themes and findings are de rigueur in virtually every single chapter, making for a book that seems quite unified as an interdisciplinary entity. What is sometimes missing is the pluralistic feel of a more multidisciplinary approach, in which the give-and-take of opposing conceptual frameworks and methodologies create a richer sense of intellectual excitement and adventure—so long as the contributors do not talk past each other. The whole here may not be greater than the sum of its parts, but readers looking for comprehensive contemporary coverage of topics in individual chapters will not be disappointed.

A scaled-down version of the Huston et al. book is Jon O. Lauring's *An Introduction to Neuroaesthetics*. There is considerable overlap in the two volumes, particularly in chapters with common authorship. Moreover, despite the range of domains encompassed by Huston and colleagues, Lauring's collection also happily includes chapters devoted to architecture and environmental design, literature, and film. These are major forms of aesthetic expression, which are given scant treatment elsewhere, and which cry out for further empirical exploration. Lauring's book also includes an extremely useful glossary, mainly of neuroscience and brain anatomy terms. The latter are also depicted in lateral and midsagittal diagrams, for easy reference. This is a boon to the uninitiated, who may either gloss over anatomical distinctions or get lost in finding their way around the brain, such that the subtractive logic of neuroimaging to localize function—the enterprise of seeing what parts of the brain "light up" under particular conditions, which is still the main way neuroaesthetics is practiced—is easily lost.

The final volume under consideration, *Aesthetic Science*, edited by Arthur P. Shimamura and Stephen E. Palmer, is less overtly concerned with purely neural aspects of aesthetics than either Huston et al.'s or Lauring's books. Its multidisciplinarity is evident in its organization: after an introductory chapter by Shimamura that is essentially a précis of his *Experiencing Art*, five chapters each are devoted to perspectives from philosophy, psychology, and neuroscience. Indeed, as the editors state in their preface to *Aesthetic Science*:

> We have called this approach *aesthetic science*, which takes its lead from cognitive science, the multidisciplinary approach that considers the nature of cognition. The goal of aesthetic science is to approach the issues by promoting meaningful dialogues among people in various disciplines. … We view this edited volume as an attempt to initiate a forum for such a multidisciplinary approach. (vii–viii)

There is a notable contrast in tone between this multidisciplinarity and the neurocentrism often evident elsewhere. Many chapters in *Aesthetic Science* stake out core issues (such as processing fluency or aesthetic emotions) from an avowedly disciplinary perspective, allowing both a rich exposition of that perspective and discussions of explicit points of contrast with adjacent domains. For me, a trained cognitive psychologist interested in empirical aesthetics, the approach developed in *Aesthetic Science* is especially satisfying, because nonneuroimaging laboratory methods often get short shrift, even though they have much to add to neuroaesthetics discussions. For instance, a provocative chapter on color preferences and spatial composition is based entirely on the standard laboratory methods of perceptual and cognitive psychology, with no neuroimaging whatsoever (Palmer, Schloss, and Sammartino 2012). The results are at least as surprising as many neuroscience findings: aesthetic responses to chromatic and spatial structure are both strongly influenced by implicit statistical knowledge of the environment.

I am now convinced that an overtly multidisciplinary, pluralistic approach like that advocated in *Aesthetic Science* would best serve the interests of the enterprise of neuroaesthetic inquiry, by preserving productive tensions between contributing domains, rather than prematurely submitting to the hegemony of neuroscience.

THE ISSUES

Many of the tensions inherent in the preceding contrast of a reductive neuroscience versus neighboring domains, including scientific psychology and the humanities, are echoed, if not exactly paralleled, in other dichotomous contrasts. These may serve as a useful set of issues to initiate a discussion of future prospects for neuroaesthetic inquiry. A few candidate dichotomies (there are many others) include (1) "difficult" art versus "easy" art, (2) creator's striving for novelty versus evolutionarily constrained aesthetic biases in audiences, and (3) the extent to which aesthetic behavior relies on explicit versus implicit mental processes. I now address these in turn.

"DIFFICULT" ART VERSUS "EASY" ART

As Zeki (2009) argued, "The first step in [neuroaesthetics] is to define the function of the brain and that of art." A tall order. The nature and definition of art, considered as a philosophical problem, has a long, diverse history, suggestive of intractability. But personally, I have never considered airtight definitions necessary for making some initial headway on a complex topic. Defining art in general may be less of an issue than considering how neuroaesthetics deals with art of very different kinds. As Dissanayake (2007) and others have pointed out, most writing and research on neuroaesthetics deals with a pitifully small subset of potential artworks, strongly biased toward realistic European masterworks. Although such works are probably prototypical of how many people think of "art," it is probably misguided to think of Western realism as the "natural" mode of art-making (Gombrich 1960). One can move away from such canonical works in several directions: toward more abstract or conceptual modernist art, to folk art, to children's art, to art in non-Western traditions, or to more natural manifestations of beauty in other people or landscapes. Many of these options are treated in the books described above, and most probably partake of a more purely biological sense of beauty. In such cases, especially for evolutionarily relevant stimuli like faces, bodies, food, and landscapes, the goal of identifying neural correlates of hedonic responses seems appropriate.

Is highly challenging modernist or conceptual art fundamentally different? Eminent art critic Blake Gopnik (2012) has argued that all art has some conceptual component. However, contemporary avant-garde art (installations,

performance, and so on), which is so strongly rooted in knowledge of modernist traditions and which appeal to criteria other than traditional notions of beauty or hedonic pleasure, may be historically unprecedented. A basic question is whether contemporary conceptual art as we experience it in galleries and museums is a historical aberration—that is, something so far removed from an evolutionary context that the foundational principles pointed to by neuroaesthetics researchers simply do not apply. Centuries hence, will installations, performance, and other nontraditional conceptual art predominate, or will much of the artwork of our time be regarded with baffled bemusement? Do the principles uncovered by neuroaesthetics researchers apply to such modes of creativity? Chatterjee, Kandel, and Rothenberg have all tried individually to deal seriously with highly modernist abstract or conceptual art in their separate works. Kranjec (2015) has done likewise in a stimulating essay on the parallels of conceptual art and cognitive neuroscience. However, this is still an understudied phenomenon, one that cries out for insightful input from art historians and also researchers of the psychology of creativity—a topic to which I now turn.

THE DRIVE FOR NOVELTY IN AN EVOLUTIONARY CONTEXT

A common critique of contemporary neuroaesthetics is its focus on receptive aspects of aesthetic behavior and a relative neglect of its more creative aspects. Only a few studies have directly examined neural correlates of aesthetic creativity (see Vartanian 2014, 2015). Moreover, the evolutionary context of creativity—both in terms of its phylogenetic origins and its continuing role in how human creativity is manifested—remains a highly speculative area (Turner 2006; Dissanayake 2007; Gabora and Kaufman 2010). My earlier question, of whether contemporary high art is decisively divorced from the evolutionary forces that engendered humanity's aesthetic faculty in the first place, takes on a heightened tone when we consider how creativity plays out in such an environment, from the creator's point of view.

Originality is typically considered an essential aspect of aesthetic creativity. However, there are unresolved questions as to how universally incessant the drive for novelty is in traditions that we regard as "artistic." Some cross-cultural studies emphasize radically different conceptualizations of creativity and art, where innovation is not prized or encouraged (Kozbelt, 2016). Indeed, some scholars have argued that even in the West our modern conception of "art" is only a few hundred years old (Shiner 2001).

Other scholars have pointed to innovation and continual style change as an inherent aspect of any manifestation of artistic creativity that is worthy of the name. Most prominent among them is the late Colin Martindale, a psychologist whose book on style change in the arts, *The Clockwork Muse* (1990), would be my unhesitating choice among writings on creativity, if I could only save one volume from the flames. Sadly, Martindale's magnum opus appears to have fallen completely out of fashion—it was scarcely, if at all, cited in any the books reviewed above. This is a great pity, as his provocative synthesis is one of the greatest intellectual achievements in all of psychological aesthetics. Martindale combined many aspects of psychological theory and significant methodological innovations (especially in computer text analysis) into a remarkably specific set of predictions, almost uniformly borne out in empirical tests. In brief, Martindale proposed that artworks within a tradition must garner ever more critical attention among an elite audience (the only one that matters for high art), typically by increasing novelty and complexity. This can be achieved by generating ever more unlikely combinations of ideas in the course of the creative process, or by devising new artistic styles

altogether. Since only one or the other of these methods is needed to capture more attention, they oscillate inversely, all the while propelling the attention-grabbing qualities of artworks higher and higher over time.

Martindale (2009) later elaborated this argument to describe the death of artistic traditions, which happens when the novelty of artworks exceeds their capacity to communicate to audiences—a moment that Martindale argued has already passed for most of the fine arts in the West:

> The high arts were defined in a way that guaranteed that they would evolve in a specific way and die in a specific way. It is time that aestheticians and critics accept what could be called the tragic end of art. It is better to do so than to continue with the hypocritical belief that things such as contemporary "happenings" have the slightest thing to do with art. Aesthetics should take its place alongside paleontology, and we should get on with our research. (139)

Despite Martindale's naysaying, do modern conceptual artworks show the same kind of transhistorical trends for arousal potential, primordial cognition, and style change that he himself has amply documented in numerous other artistic traditions? Such a litmus test would provide some important constraints on neuroaesthetic discussions of highly conceptual art, but this is unexplored territory.

Other aspects of Martindale's research also inform the creative dynamic of high-level art, where creators continually strive for novelty. In one paper, Martindale (2007) accounted for about two dozen aesthetic regularities via basic properties of neural networks, arguing that principles of psychological aesthetics are likely to be principles of general psychology. Observed statistical regularities in artworks (e.g., Graham and Redies 2010) make a similar point—regardless of the specific evolutionary selection mechanism, human aesthetic artifacts are not nearly as varied as they in principle could be (Kozbelt, 2016). Assuming that there is a strong evolutionary backstory for basic constraints on processing and preferences among members of their audience, creators have a real problem if they seek novelty that fundamentally goes against the grain of our canalized aesthetic biases. Despite creators' best efforts, certain forms of innovation may resist wide appreciation indefinitely.

Alternatively, assuming many styles of artworks can speak to and exploit fundamental aspects of evolutionarily based neural processing, there should still be great scope for art to do what it does very effectively. In this sense, enduring aesthetic productions that naturally tap into the way our minds work constitute something like genuine *discoveries*, along the neuroaesthetics party line of artist as intuitive neuroscientist. This can be contrasted with the novelty aspect of mere *inventions*, which are more arbitrary and may gain transient notoriety without necessarily achieving long-term canonical status. Indeed, far from uniformly prioritizing novelty as the criterion of creativity, some (e.g., Kozbelt 2009) have emphasized value, or adaptive solutions to problems, as more fundamental to sustainable, impactful creativity. Along similar lines, Samuel Johnson wrote: "Nothing can please many, and please long, but just representations of general nature" (Johnson [1773] 2000, 420). Much meaning here.

In any case, the long-term dynamic of creative innovation versus the reception by audiences discussed by Martindale (2009) remains almost entirely unstudied. Thus we have no real sense of the possible scope for meaningful coevolution of aesthetic responses between creators and audiences, or even how to measure many of the most relevant constructs. Here is a clear example of a phenomenon where the full complement of domains contributing to neuroaesthetics could make significant inroads. But so far no one has taken up the challenge.

EXPLICIT VERSUS IMPLICIT AESTHETIC PROCESSES

Careful psychological understanding of the mental processes involved in aesthetic creation or reception is certainly a complex research agenda, but it is necessary for making headway on these issues. The many ways in which aesthetic information might be processed can be loosely divided into conscious (or explicit) versus unconscious (or implicit) ways, a common psychological distinction in many aspects of perception, cognition, and decision-making.

Implicit cognitive processes have always been more mysterious than explicit ones. The extent to which aesthetic choices are ultimately implicit seems to tap into something fundamental about aesthetic processing. In keeping with Orians's discussion of basic root fears and desires, which are hard to explain and harder to explain away, many implicit aspects of information processing seem to bear strongly on our aesthetic experience—as in Palmer, Schloss, and Sammartino's (2012) work on color preference and spatial composition I cited earlier. In another chapter in *Aesthetic Science*, on the ease (or fluency) of information processing as a determinant of aesthetic pleasure, Reber (2012) discusses this issue. Intriguingly, he argues that though fluent processing of a stimulus typically leads to positive affect, this effect is moderated by attribution: hedonic pleasure will be higher if the source of fluency in processing is unknown and it comes as a surprise. In many ways, then, the paradigmatic aesthetic moment (in appreciation or in creation) comes down to choices that must be made but where the reasons for the choice are unknown. This may apply similarly to both high-level expert decisions in painting, poetry, or music composition, and also to more mundane questions like deciding which pair of shoes goes better with a particular outfit.

Fittingly, this mode of cognition recalls the original modern formulation of the term "aesthetics" by Baumgarten (1750), where it was taken to mean "taste," "a sense of beauty," or, most provocatively, "sensory cognition," in contrast both to mere sensation and to more consciously logical modes of thought (see also Martindale 2007). There may be a great deal of prescience in Baumgarten's characterization—enough to spawn empirically testable propositions that get to the heart of the matter with regard to both the reception of aesthetic products and the creative processes that give rise to them in the first place. Long-standing arguments about the degree to which cognitive processes in insight and creativity operate in a largely blind, nonconscious fashion (Simonton 2011) are also consistent with this interpretation of Baumgarten. A final point of relevance is an evolutionary aspect of aesthetics as sensory cognition, a point abundantly alluded to along the lines of Orians's discussion of "ghosts of the savannah"—aesthetic predispositions rooted deep in our evolutionary past, which we are (or are not?) powerless to overcome, either as creators or as consumers of aesthetic productions. Over the past few decades, psychological methodologies for studying implicit processes have greatly developed, and they are now a staple of research in many subdomains of psychology. Their application to aesthetic processing will be an important ongoing contribution to an aesthetic science, and, maybe, to neuroaesthetics as it continues to define itself.

Coda

The coming of age of neuroaesthetics is an event both to applaud and to ponder. It is probably fair to say that neuroscience still exerts the greatest influence on the domain. However, a more multidisciplinary approach, combining the strengths of scientific psychology, evolutionary biology, philosophical aesthetics, art history, and other allied domains, seems to me the most likely strategy for yielding deep, rich, and insightful connections in this astoundingly complex and interdisciplinary endeavor. Such linkages are hinted at in many of the books

reviewed here, but they are most apparent in Shimamura and Palmer's conception of an aesthetic science. If I have any critique of their proposal, it is a plea for an even more prominent role for evolutionary biology and evolutionary psychology.

As Theodosius Dobzhansky (1973) famously noted, "Nothing in biology makes sense except in the light of evolution" (125). The extent to which the same is true of human aesthetic behavior—a path of inquiry whose modern foundations are right now being laid by advances in neuroaesthetics—is an open question. Wedge issues like the status of conceptual art, tensions between innovation and canalized preferences, and the centrality of implicit processing make for a set of very hard problems—one that I believe will only yield to a coordinated multidisciplinary assault.

WORKS CITED

Baumgarten, Alexander G. 1750. *Aesthetica*. Hildesheim: Georg Olms.

Chatterjee, Anjan, and Oshin Vartanian. 2014. "Neuroaesthetics." *Trends in Cognitive Sciences* 18 (7): 370–75.

Darwin, Charles. 1871. *The Descent of Man and Selection in Relation to Sex*. London: John Murray.

Deacon, Terrence W. 2010. "Colloquium Paper: A Role for Relaxed Selection in the Evolution of the Language Capacity." *Proceedings of the National Academy of Sciences USA* 107 (Supplement 2): 9000–9006.

Dissanayake, Ellen. 2007. "What Art Is and What Art Does: An Overview of Contemporary Evolutionary Hypotheses." In *Evolutionary and Neurocognitive Approaches to Aesthetics, Creativity, and the Arts*, edited by Colin Martindale, Paul Locher, and Vladimir M. Petrov, 1–14. Amityville, NY: Baywood.

Dobzhansky, Theodosius. 1973. "Nothing in Biology Makes Sense Except in the Light of Evolution." *American Biology Teacher* 35(3): 125–29.

Gabora, Liane, and Scot Barry Kaufman. 2010. "Evolutionary Approaches to Creativity." In *The Cambridge Handbook of Creativity*, edited by James C. Kaufman and Robert J. Sternberg, 279–300. New York: Cambridge University Press.

Gombrich, Ernst H. 1960. *Art and Illusion*. Princeton, NJ: Princeton University Press.

Gopnik, Blake. 2012. "Aesthetic Science and Artistic Knowledge." In *Aesthetic Science: Connecting Minds, Brains, and Experience*, edited by Arthur P. Shimamura and Stephen E. Palmer, 129–59. New York: Oxford University Press.

Gould, Stephen J., and Lewontin, Richard C. 1979. "The Spandrels of San Marco and the Panglossian Paradigm: A Critique of the Adaptationist Programme." *Proceedings of the Royal Society Series B: Biological Sciences* 205 (1161): 581–98.

Graham, Daniel J., and Christoph Redies. 2010. "Statistical Regularities in Art: Relations with Visual Coding and Perception." *Vision Research* 50:1503–9.

Johnson, Samuel. (1773) 2000. "Preface to the Plays of William Shakespeare" (4th ed.). In *Samuel Johnson: The Major Works*, edited by Donald Greene, 419–56. New York: Oxford University Press.

Kozbelt, Aaron. 2009. "The Evolution of Evolvability Applied to Human Creativity." *International Journal of Creativity and Problem Solving* 19 (1): 101–21.

_____. 2016. "Creativity and Culture in Visual Art." In *The Palgrave Handbook of Creativity and Culture*, edited by Vlad Glăveanu, 573–94. Hampshire, UK: Palgrave.

Kranjec, Alexander. 2015. "Conceptual Art Made Simple for Neuroaesthetics." *Frontiers in Human Neuroscience* 9 (Article 267): 1–5.

Martindale, Colin. 1990. *The Clockwork Muse: The Predictability of Artistic Change*. New York: Basic Books.

_____. 2007. "A Neural-Network Theory of Beauty." In *Evolutionary and Neurocognitive Approaches to Aesthetics, Creativity, and the Arts*, edited by Colin Martindale, Paul Locher, and Vladimir M. Petrov, 181–94. Amityville, NY: Baywood.

_____. 2009. "The Evolution and End of Art as Hegelian Tragedy." *Empirical Studies of the Arts* 27 (2): 133–40.

Miller, Geoffrey F. 2000. *The Mating Mind: How Sexual Choice Shaped the Evolution of Human Nature*. New York: Anchor.

Palmer, Stephen E., Karen B. Schloss, and Jonathan Sammartino. 2012. "Hidden Knowledge in Aesthetic Judgments: Preferences for Color and Spatial Composition." In *Aesthetic Science: Connecting Minds, Brains, and Experience*, edited by Arthur P. Shimamura and Stephen E. Palmer, 189–222. New York: Oxford University Press.

Ramachandran, Vilayanur S., and William Hirstein. 1999. "The Science of Art: A Neurological Theory of Aesthetic Experience." *Journal of Consciousness Studies* 6 (6–7): 15–51.

Ramachandran, Vilayanur S., and Elizabeth Seckel. 2012. "Neurology of Visual Aesthetics." In *Aesthetic Science: Connecting Minds, Brains, and Experience*, edited by Arthur P. Shimamura and Stephen E. Palmer, 375–89. New York: Oxford University Press.

Reber, Rolf. 2012. "Processing Fluency, Aesthetic Pleasure, and Culturally Shared Taste." In *Aesthetic Science: Connecting Minds, Brains, and Experience*, edited by Arthur P. Shimamura and Stephen E. Palmer, 223–49. New York: Oxford University Press.

Shiner, Larry. 2001. *The Invention of Art: A Cultural History.* Chicago: University of Chicago Press.

Simonton, Dean Keith. 2011. "Creativity and Discovery as Blind Variation: Campbell's (1960) BVSR Model after the Half-Century Mark." *Review of General Psychology* 15 (20): 158–74.

Snow, Charles P. 1959. *The Two Cultures and the Scientific Revolution*. New York: Cambridge University Press.

Solso, Robert. 1994. *Cognition and the Visual Arts*. Cambridge, MA: MIT Press.

_____. 2003. *The Psychology of Art and the Evolution of the Conscious Brain*. Cambridge, MA: MIT Press.

Turner, Mark, ed. 2006. *The Artful Mind.* New York: Oxford University Press.

Vartanian, Oshin, 2014. "Generating Aesthetic Products in the Scanner: fMRI Studies of Drawing, Story Writing, and Jazz Improvisation." In *An Introduction to Neuroaesthetics*, edited by Jon O. Lauring, 341–53. Copenhagen: Museum Tusculanum Press.

_____. 2015. "Neuroimaging Studies of Making Aesthetic Products." In *Art, Aesthetics, and the Brain*, edited by Joseph P. Huston, Marcos Nadal, Francisco Mora, Luigi F. Agnati, and Camilo J. Cela-Conde, 174–85. New York: Oxford University Press.

Vessel, Edward A., G. Gabrielle Starr, and Nava Rubin, 2012. "The Brain on Art: Intense Aesthetic Experience Activates the Default Mode Network." *Frontiers in Human Neuroscience* 6 (Article 66): 1–17.

Wilson, Edward O. 1998. *Consilience: The Unity of Knowledge*. New York: Vintage.

Zahavi, Amotz. 1997. *The Handicap Principle: A Missing Piece of Darwin's Puzzle.* New York: Oxford University Press.

Zeki, Semir. 1999. *Inner Vision: An Exploration of Art and the Brain*. New York: Oxford University Press.

_____. 2009. *Statement on Neuroesthetics*. Accessed January 11, 2016. http://www.neuroesthetics.org/statement-on-neuroesthetics.php.