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What Is the Cognitive Neuroscience of Art... and Why Should We Care?

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There has been considerable interest in recent years in whether, and if so to what degree, research in neuroscience can contribute to philosophical studies of mind, epistemology, language, and art. This interest has manifested itself in a range of research in the philosophy of music, dance, and visual art that draws on results from studies in neuropsychology and cognitive neuroscience.¹ There has been a concurrent movement within empirical aesthetics that has produced a growing body of research in the cognitive neuroscience of art.²

However, there has been very little collaboration between philosophy and the neuroscience of art. This is in part due, to be frank, to a culture of mutual distrust. Philosophers of art have been generally skeptical about the utility of empirical results to their research and vocally dismissive of the value of what has come to be called *neuroaesthetics*. Our counterparts in the behavioral sciences have been, in turn, skeptical about the utility of stubborn philosophical skepticism. Of course attitudes change...and who has the time to hold a grudge? So in what follows I would like to draw attention to two questions requisite for a rapprochement between philosophy of art and neuroscience. First, what is the cognitive neuroscience of art? And second, why should any of us (in philosophy at least) care?

There are obvious answers to each of these questions. The cognitive neuroscience of art is a subdivision of empirical aesthetics devoted to just that, the application of neuroscientific methods to the study of our engagement with artworks (more on the cognitive bit later).

Why should we care? Neuroscience helps us sort out the kinds of information processing involved in our psychological engagement with the world. So neuroscience is germane to the task of evaluating whether philosophical theories about our engagement with art reflect our best understanding of the psychological processes that underwrite them. But, of course, this claim is really just a hackneyed naturalistic platitude. And platitudes too often leave too many stones unturned to be of much use. The devil is always in the details.

In this case the devil is a question of pragmatics, or a question about the real methodological utility of neuroscientific research to aestheticians and philosophers of art in particular cases. So the obvious answers turn out not to be so easy.

I am not sure there was a *neuroscience of art* a decade or so ago. There is a branch of experimental

psychology called *empirical aesthetics*. This field traces its roots back to a book published in 1871 by Gustav Fechner called, of all things, *On Experimental Aesthetics*. Fechner was a key figure in the development of the new field of psychology in the nineteenth century (he was instrumental in the development of psychophysics). So empirical aesthetics is as old as psychology itself. This should come as no surprise. Alexander Baumgarten introduced the term "aesthetics" in the eighteenth century to refer to a science of sensuous cognition. Nonetheless, a decade ago the idea of a genuine experimental neuroscience of art was only just emerging as a productive possibility. The literature consisted largely of pieces drawing connections between results in neurophysiology, facts about the formal structures of particular artworks, and anecdotal stories about the productive practices of

particular artists.³ This literature pointed towards the promise of a neuroscience of art. But it was missing the marks of a true experimental science: empirically testable hypotheses and associated experimental research.⁴ This is changing.

A general model for a cognitive neuroscience of art has emerged from this early literature.⁵

Artists develop general formal vocabularies and particular compositional strategies via a systematic exploration of the behavioral effects of different sets of marks, movements, tones, rhythmic patterns, or narrative devices.

We need not overlay the use of the term 'systematic' in this context.

The process need not be explicit. The claim is simple and pragmatic: formal strategies develop relative to their success or failure as a means

to evoke desired behavioral responses in consumers. This suggests a means to evaluate artworks as a class of stimuli. Cognitive science,

in its most general sense, is the study of the ways organisms acquire, represent, manipulate, and use information in the production of behavior,

or to coin an awkward acronym, ARMUI. Artworks are stimuli

intentionally designed to induce a range of affective, perceptual, and cognitive responses in readers, spectators, viewers, and listeners.

This suggests that we can model our engagement with artworks as an information processing problem: how do consumers acquire, represent, and manipulate information carried in the formal structure

of these stimuli, and what is the relationship between these processes and those explicit behaviors associated with our canonically artistic

engagement with this range of artifacts? Cognitive neuroscience is a tool that can be used to model these processes and behaviors. These

models can in turn be used to evaluate alternative hypotheses about the nature of our engagement with artworks in a range of media. The

answers to these kinds of questions can be used to gain traction in debates about the nature of art more generally. Therefore cognitive

neuroscience is a tool that can be productively used to explore questions about the nature of art and aesthetic experience.

Why a *cognitive* neuroscience of art? I am often surprised by the degree to which the folks I interact with on the neuroscience side of these endeavors are committed to a core aestheticism. In this regard the term 'neuroaesthetics' isn't just a name. It reflects an ideological bias about the nature of art. And this is a sticking point. I take it that

issues germane to theories in aesthetics and the philosophy art can be peeled apart. There are questions about the aesthetics of nature,

industrial design, graphic design, etc., that are not artistic questions. There are questions about the meanings of artworks and the nature

of our engagement with characters that are not aesthetic questions. More importantly, the philosophy of art encompasses questions

concerning artistically salient aesthetic phenomena, but aesthetics does not encompass non-aesthetic semantic or ontological questions

about the nature of art or our engagement with artworks. Therefore, not only are these two sets of concerns distinct, but the philosophy of

art represents a broader view of art than aesthetics. Likewise, biased competition models for selective attention demonstrate a close connection

between the meaning, identity, or semantic salience we attribute to a stimulus and the affective and perceptual features constitutive

of our phenomenal experience of it. Cognitive neuroscientists use fronto-parietal attentional networks (feedback loops) that connect

prefrontal areas (areas associated with object identification, working memory, and the attribution of affective salience to a stimulus)

to sensory processing in the visual, auditory, and somatosensory systems to model these effects.⁶ This suggests that the answers to

questions about the semantic salience of artworks generally, issues that are central to the philosophy of art, play a regulative role at a neurophysiological level in determining the aesthetic quality of our engagement with particular artworks. Therefore a cognitive neuroscience of art represents a broader view of art than neuroaesthetics.

So, what's in a name...? The change I have proposed is an attempt to realign the research program within neuroscience in order to bring it into register with a more realistic view of the range of issues pertinent to the study of art.

Of course, it is one thing to have a general, abstract model for the potential contribution of neuroscience to philosophy of art. It is another thing to have a good set of case studies that show that the model works passably well in a dirty, noisy, uncooperative environment. And this is where the pesky, persistent, nagging question, "Why should we care?" becomes important. For a long time the received dogma in computational theories of mind was that neuroscience is implementation-level science. Questions about the nature of a target behavior, what a system is doing, how does it represent information, etc., could be answered through functional level analysis. Neuroscience might tell us how these representations and processes were realized in a type of organism. But this, it was thought, wouldn't contribute much to our understanding of its psychological behavior. This may not always be the case. The scenario I am envisaging is one in which a range of mutually inconsistent alternative theories are each consistent with the observable aspects of some target behavior. If evidence from neuroscience can provide some traction in our understanding the way a system in fact acquires, represents, manipulates or uses information in the production of the target behavior, then neuroscience contributes something novel to our understanding of what the system is doing, or the nature of the target behavior. The result need not necessarily favor one alternative over another. We might instead be forced to reconsider the distinctions that differentiate the alternatives. The canonical case study for this kind of claim in cognitive science is the imagery debate where, dogged disagreements about format aside, evidence from neuroscience demonstrates that modality specific imagery and perception share modality specific processing resources.⁷ I have argued that the debate between Simulation and Theory-Theory approaches to narrative understanding provides an analogous example in philosophy of art.⁸

So one reason we should care is that neuroscience can contribute helpful information to entrenched philosophical debates. However, the utility of neuroscience to the philosophy of art does not hinge on the success of its application in controversial case studies. It is sufficient that neuroscience can help us gain traction in understanding the way artworks work, e.g., how they carry and convey their content. For instance, Noël Carroll has argued that part of the power of movies lies in their capacity to direct attention and frame the way we conceptualize and experience film narratives. In particular, he argues that filmmakers use various in-camera effects and editing techniques to focus viewer attention on particular aspects of scenes diagnostic for a directed interpretation of the narrative. These features determine the salience of current actions and events, foreshadow future actions and events, color our retroactive interpretation of previously depicted actions and events, shape our moral expectations about the unfolding lives of characters, and thereby drive our understanding

and appreciation of movies. Mark Rollins argues analogously that paintings are perceptual stimuli intentionally designed to direct the attention of viewers toward their aesthetically and semantically salient features. Rollins argues that these strategies work by virtue of the fact that artists' formal and compositional strategies tend naturally to become tuned to the operations of perceptual systems over time. This model can be generalized to other media. In this regard, artworks can generally be interpreted as exogenous, or externally imposed, attentional routines that carry the intentions of the artist. Carroll and Rollins thereby treat artworks as *attentional strategies*.⁹ I propose that we shift the burden of responsibility away from the artist to the artwork in these contexts (in part to allow for contextual variance and avoid murky philosophical questions about the role of artists' intentions in interpretation) and call them *attentional engines*, or stimuli designed to independently induce a range of experiences in consumers.

Research by Uri Hasson and his colleagues supports this general view of artworks.¹⁰ There is a methodological problem that is a sticking point for any rapprochement between philosophy of art and neuroscience. Our engagement with artworks, like natural vision more generally, is messy. It doesn't reduce neatly to the kinds of contexts that yield successful neuroimaging experiments. In a standard imaging study one systematically varies the value of one aspect of a stimulus, e.g., the brightness of a color patch. This yields carefully controlled data about change in underlying neurophysiological processes that enables researchers to make inferences about discrete aspects of information processing in the brain. The trouble is that this method is poorly suited to spatiotemporally complex, dynamic stimuli whose content is constrained by a range of ill-defined contextual features, (e.g., film, dance, and natural vision). Hasson has developed a means to overcome this problem for natural vision using what he calls inter-subject correlation analysis (ISC). ISC is used to measure and compare the changing rate of activation over time in different brain regions among a range of participants who have been exposed to the same dynamic stimulus. Film and video are a means to present a repeatable dynamic scene to any number of participants. Therefore they are ideally suited stimuli for these experiments. Hasson has thereby winged two birds with one stone. He has developed a method for studying vision in (more) ecologically valid natural contexts that is also a valid method for a neuroscience of film.¹¹

Hasson's studies yield several types of results that support the interpretation of films as attentional engines. For instance, in one study participants were asked to lie on their backs in a scanner and watch the opening 30 minutes of *The Good, the Bad, and the Ugly* (1966). The movie was presented on a computer screen and viewed in a mirror mounted over participants' eyes. The sound track was provided via specialized headphones designed for use within the noisy, magnetized environment of the scanner. The instructions were simply to watch the movie. Participants were free to choose what to look at, how long to look at it, etc. Despite the uncontrolled nature of the free viewing task there were high, statistically significant ($p < 0.001$) inter-subject correlations in visual areas involved in sensory processing, pattern, form, and face recognition, auditory areas (Herschel's Gyrus), language areas (Wernicke's Area), areas associated with emotional processing, and multisensory areas.¹² All in all ISC demonstrated timelocked

processing among subjects in approximately 45% of cortex.

These results contrast with results recorded from among groups of participants who were in complete darkness in the scanner and sets of participants who viewed different segments of the same movie. In neither case was there any evidence of ISC correlations. These results are interesting. However, they need not, in and of themselves, reveal anything significant about our engagement with movies. The trouble is the free viewing task. What one really needs is a way to analyze what participants are doing in order to confirm that the ISC measure reflects commonalities in the way participants attend to the film. This information emerges from two sources in Hasson's research. Eyetracking data and gaze maps demonstrate that participants fixated their attention on the same locations at the same time while viewing the clip.¹³ These results were replicated and extended in a separate study. Here Hasson compared ISC, eye movement, and gaze map data collected from a 10 minute clip of *The Good the Bad, and the Ugly* and a 10 minute, unstructured, one shot video of a people coming and going while listening to a Sunday morning concert in Washington Square Park in New York City. The unstructured real life event evoked far less ISC than the tightly edited film, particularly in areas beyond those associated with basic sensory processing.¹⁴ Further, eye movements and gaze maps were closely correlated in responses to *The Good the Bad and the Ugly*, but in responses to the video of the unstructured real life event eye movements wandered and participants did not attend to the same locations.

So. There is a story about the cognitive neuroscience of art. There is a suggestion from within philosophy that movies are attentional engines, or that filmmakers have developed a set of techniques designed to capture and direct viewer attention to those affective and semantically salient aspects of scenes that carry critical information for the construction of film narratives. Hasson's research lends support to this claim. I have focused on his work on visual attention in this discussion. These results generalize to ISC measures for the influence of auditory processing of soundtracks in our visual engagement with movies and are independently supported in research by Nicole Speer and her colleagues.¹⁵ A biased competition model of selective attention can be used to model the associated behaviors.¹⁶ In ordinary contexts, selection is a critical problem for perception. The environment is replete with information, only a small subset of which is salient in any given context. Add the fact that our basic processing resources are limited and we can readily see that we need a means to selectively filter information on the fly in order to efficiently collect the information necessary to achieve our immediate goals in real time. Biased competition models describe fronto-parietal attentional networks that direct eye movements, bias the sensitivity of populations of neurons in sensory cortices to goal related features of the environment, and thereby explain the influence of task relevance, semantic salience, and affective salience in perception and attention. These processes can, in turn, be used to model artworks in a range of other media as attentional engines.¹⁷

I suppose that in some sense none of this is a surprise. We perceive movies. One ought to, therefore, be able to model some aspects of our engagement with movies perceptually. It is likely true that this kind of claim generalizes to any of a range of non-art film and video stimuli, e.g. athletic contests and the nightly news. So, the question

risers again...“Why should a philosopher care?” The short answer is that it gives us traction in understanding how artworks work. The longer answer is that an understanding of our engagement with artworks is important because, in the long run it should give us greater traction in a range of problems we are interested in. Is there a risk of default on this promissory note? I suppose. It is, after all, an empirical question how far this model generalizes to questions of interest to philosophers of art. However, artworks are cognitive stimuli. Therefore, whatever else we might think about issues of ontology or value, everything in the philosophy of art rides (I am willing to argue) on answers to questions about our engagement with actual artworks. These are by and large psychological questions about the ways we acquire, represent, manipulate, and use information in the production of behavior. Neuroscience is in the business of modeling answers to these kinds of questions. Where this can contribute information to help sort out difficult questions, resolve entrenched debates, or simply help confirm our best theories about the way artworks work, neuroscience can make a productive contribution to philosophical practice. I’m willing to bet that a few (more) cases like this will emerge.

Endnotes

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6. See Seeley & Kozbelt, 2008; S. Duncan and L. F. Barrett, "Affect Is a Form of Cognition: A Neurobiological Analysis," *Cognition and Emotion*, 21(6), 2007, pp. 1184-1211; S. Kastner, "Attentional Response Modulation in the Human Visual System," in M. I. Posner, ed., *Cognitive Neuroscience of Attention* (New York: Guilford Press, 2004), pp. 144-156; L. Pessoa, S. Kastner, and L. G. Ungerleider, "Attentional Control of the Processing of Neutral and Emotional Stimuli," *Cognitive Brain Research* 15, 2002, pp. 31-45.
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10. For a review of these studies see U. Hasson, O. Landisman, B. Knappmeyer, I. Vallines, N. Rubin, and D. J. Heeger, "Neurocinematics: The Neuroscience of Film," *Projections: The Journal for Movies and Mind*, 2(1), Summer 2008, pp. 1-23.
11. See D. J. Levitin, *This Is Your Brain on Music* (New York: Dutton, 2006) for an analogous claim about audition and neuroscience of music.
12. See Hasson, 2008, figure 2.
13. See Hasson, 2008, figure 3.
14. See Hasson, 2008, figure 4.
15. Speer et al, 2009; Hasson et al, 2008. Hasson has also found systematic differences in ISC between different genres, e.g., a continuum from high to moderate ISC for Hitchcock suspense thrillers, Spaghetti Westerns, and contemporary sitcom comedies respectively.
16. See Seeley and Kozbelt, 2008; Rollins, 2004.
17. W. P. Seeley, "Seeing How Hard It Is: Selective Attention and Cross Modal Perception and the Arts," unpublished manuscript presented at the Eastern Division Meeting of the American Philosophical Association, December, 2010.

Where There Be Dragons: Finding the Edges of Neuroaesthetics

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Neuroaesthetics is just starting to be mapped. Its territories and boundaries are not well defined. In these early days, you might ask why philosophers should care about what neuroscientists have to say about aesthetics. Let me ask the complementary question. Why should neuroscientists care about what philosophers have to say about neuroaesthetics? The answer to this question is pretty standard fare. Stuck in the mess and mire of incremental science, most neuroscientists do not have the time or the training to step back and take a broad view of what we are doing, even though that might be precisely what is needed in these early days. We ought have a sense of where we are and where we might go. That, after all, is what maps are about. Refining early maps or drawing new ones is where philosophers could be extremely helpful. What is worth knowing better, what is unknown but knowable, and what should we simply pass over?

To date, different kinds of writings get called neuroaesthetics. One kind of writing, which I have referred to as parallelism, receives a lot of attention. It is a form of speculative science that says that things artists do have parallels in how the brain works.¹ This approach drapes art and aesthetics with neuroscience. Thus, one might propose that artists during the early twentieth century were dissecting their visual world and in the process “discovered” modules that neuroscientists later found in the visual brain. Or one might point out that artists paint in a way that better fits our mental representation of objects rather than the physics of light, shadow and color of the object’s physical presence in the world. Or one might make sweeping claims about perceptual principles that are used by artists to “explain” aesthetic experiences. Regardless of the merits of these claims, which would need to be evaluated individually, let us be clear about one thing. Speculative science trades on neuroscience, but isn’t doing neuroscience. By that I mean it does not articulate clear theoretical frameworks, propose testable hypotheses or design experiments. Conjecture is often presented as conclusion. When philosophers bother

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with neuroaesthetics, unfortunately, speculative science is often what they are bothered by.² I suggest that philosophers turn their attention to experimental neuroaesthetics, perhaps by looking at the recent edited volume by Skov and Vartanian³ or recent reviews⁴ including (self-servingly) one that I wrote. This is where conceptual clean up by philosophers could be useful.

As an experimental science, neuroaesthetics starts with a critical core of sensations, emotions and semantics. Each of these domains can be

studied to varying degrees in isolation or in combination or in the context of an aesthetic experience. Note that this basic core applies to natural scenes, to the design of artifacts, as well as to artworks. In other words, this core cuts across aesthetics and art. The connection between sensations and emotions is most amenable to neuroaesthetics inquiry. We can look for stable regularities of light, line, color and form in artwork that are pleasing and relate them to the kinds of neural coding for which our brains seems designed. We can make inferences about the kind of emotions evoked by aesthetic experiences in general and to artwork in particular. Much of the research on aesthetic emotion thus far has been on preferences in a fairly simple way. The focus has been on beauty and whether people like what they see. However, these are starting points in an early research program and nothing in principle restricts neuroscience experiments to a beauty-preference axis. Neuroscience might have something to say about more complex combinations of emotions and reward systems. For example, we are learning more about the psychology and neuroscience of anxiety and that of disgust. Experiments looking at artworks that gain force by creating anxiety or evoking disgust could be designed. One could ask if these typically negative emotions, in an aesthetic context, become pleasurable.

Unlike sensations and emotions, when it comes to semantics in art, we run into the limits of what neuroscience can offer. Current neuroscientific methods are best at examining the biology of our minds for things that are stable and relatively universal. However, if the meaning of an artwork changes over time and relies on interactions with its cultural context and the local prejudices of the viewer, then it will be too slippery for neuroscience. Most neuroscientific approaches to semantics cannot deal with this level of complexity. The bulk of neuroscience work in semantics is at the level of single words and objects. How do we recognize or know a lemon or a lion? There is interest in the semantics of actions and events as structured by verbs and simple sentences. This level of analysis adds complexity by going beyond what things are, to what things do in the world. There is even limited work on discourse and on the brain bases for metaphors. However, these forays into semantics by neuroscience are a far cry from the multi-layered meanings and references that art historians and critics peel away when interpreting art.

Getting back to conceptual cartography. Imagine an early sixteenth century map of the world. In this map, the contours of Europe and Asia and Northern Africa are pretty well worked out. But, some coastlines and interiors lack detail. Off to the west, there is some sense of a "new world," but even the basic contours of this world are not worked out. Even less accessible is the topography under the oceans. Neuroaesthetics faces an old world, a new world and a sub-oceanic world. The sub-oceanic worlds are realms that we cannot reach with available neuroscience methods. As I alluded to, one of these inaccessible realms is art interpretation as understood through the analysis of cultural and social meanings layered on individual works of art. At the other end, we might have a lot to say about the details of the old world. We might show how the brain segregates encounters with paintings that emphasize color from those that emphasize form, or the way different parts of our visual cortex responds to landscapes as compared to portraits. We might learn more about the reward systems and its connection to emotions as people look at

art. This kind of research adds detail to our understanding of aesthetic encounters, but does so within systems on which there is general agreement. For example, it is hard to conceive of a neural system in which landscape paintings would not activate the parahippocampal place area and that facial portraits do not activate the fusiform face area, parts of the brain that respond to photographs of landscapes and faces respectively. Beyond the obvious, there are questions within this old world that are of great interest to neuroscientists, but might not engage folks in the humanities. One such question would be whether visual processing areas evaluate objects in addition to classifying them. Does the fusiform face area also respond to the beauty of faces in addition to classifying them as one kind of object? Work from my lab suggests that these perceptual classification systems might also be evaluating faces.⁵ Not everybody reports this finding. Resolving this discrepancy would be of great interest in understanding how the nervous system partitions circuitry dedicated to classifying or to evaluating things. But, understanding the neural organization of this partitioning will not alter the basic idea that we have classification systems and evaluation systems.

A fundamental challenge for neuroaesthetics is understanding new worlds. Can we discover new things about aesthetics? More pointedly, even within experimental aesthetics, can neuroscience methods deliver something beyond what can be learned from behavioral experiments alone? Let me offer one example of the kind of question that comes to mind. We know that if asked whether one likes a painting, knowledge about the painting influences what the person says. However, just from this behavioral observation, it is not clear that the person's emotional experience of the art is altered. They might claim to like the work because they like the knowledge they have of it or because they have learned they should like it. However, preliminary data suggest that this kind of cognitive response is probably not how it works. In a recent imaging study people looked at patterns that they thought were either taken from museums or generated by computers. The participants had greater activity in the medial orbitofrontal cortex for the same images when they were thought to be museum pieces.⁶ From the fact that neural activity in a location known to index rewards is modulated by context, we can reasonably infer that information actually changes the emotional experience. This observation tells us something about the nature of the aesthetic experience as affected by knowledge, something that we might not have known strictly through introspection or behavioral observation. While neuroscience is not ready to deal directly with interpreting the complex content of artwork, it can address the effects of knowledge of that content. Admittedly, the knowledge in the experiment I described is one-dimensional compared to the multiple dimensions of knowledge that apply to art interpretation. But, the experiment points the direction that such studies could take. I should be clear that such studies would be directed at how knowledge influences the encounter with a work of art and not the meaning of the work. A fundamental challenge for neuroaesthetics is identifying these kinds of research questions that are relevant, tractable and would potentially reveal new insights into aesthetics.

Perhaps experimental neuroaesthetics is too early in its own evolution and not settled enough to make it worth philosophers stepping in. But, whenever the time is right, now or in the near future, this is

the level at which the analytic tools of philosophers could be helpful to neuroscientists. Further discussion of speculative neuroaesthetics does little to advance the field. Some philosophers have dipped into the murky world of experimental neuroaesthetics⁷ and I hope more will follow. As we navigate in the haze of this emerging field, it would be nice to be clear when we are scrutinizing old lands and what we might learn from them. It would also be helpful to know when shapes in the distance are new lands and what new discoveries we might make if we were to land there.

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What Should We Expect from the New Aesthetic Sciences?

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As William Seeley reminds us in his article (this issue), the scientific study of aesthetics can be traced back to the beginning of experimental psychology and the work of Gustav Theodor Fechner in the second half of the nineteenth century. Among other things, Fechner showed that certain abstract forms and proportions are naturally pleasing to our senses. For example, he conducted experiments to show that a rectangle is most pleasing when its side lengths are in the golden ratio of approximately 1:1.618. He argued that the empirical study of

aesthetics must proceed from the bottom up, where aesthetic concepts and principles are assembled from individual pieces of objective knowledge. This approach, which he called “aesthetics from below,” contrasted sharply with what he called “aesthetics from above” (or philosophical aesthetics) in which knowledge of aesthetic phenomena was derived primarily from conceptual and introspective analysis. Continuing in Fechner’s footsteps, experimental psychologists in the second half of the last century have identified a wide range of factors influencing our aesthetic responses. For example, they have shown that our judgments of aesthetic preference and our feeling of aesthetic pleasure are governed by stimulus symmetry, complexity, novelty, and familiarity, among other factors.¹

Given the long history of empirical aesthetics, there can be no doubt that this field of study has made a significant contribution to our understanding of at least some aspects of aesthetic response. This contribution extends beyond the early findings that were obtained using simple or ordinary objects (e.g., geometrical shapes and human faces), to recent studies that use artworks as stimuli. But to what extent can empirical studies further understanding of our aesthetic engagement with artworks?

One way of answering this question is to reflect on the goal of aesthetic science. The psychologist Rolf Reber recently suggested that “art theorists... define the criterion of what the [aesthetic] experience is expected to be; scientists... provide a test of whether this criterion is fulfilled.”² Or consider the case of neuroaesthetics. This new branch of empirical aesthetics is often defined as the study of the neural processes underlying aesthetic experience. In other words, the job of neuroaestheticians is to discover where and how the different components of our aesthetic responses are implemented in the brain. If this is all we can expect from neuroaesthetics (or aesthetic science in general), then perhaps there is cause for skepticism about the utility of empirical aesthetics to researchers in the humanities. But is this all it has to offer?

Jerry Fodor once made the following remark about the idea that neuroscience, and functional neuroimaging data in particular, might help us understand how the mind works:

It isn’t, after all, seriously in doubt that talking (or riding a bicycle, or building a bridge) depends on things that go on in the brain somewhere or other. If the mind happens in space at all, it happens somewhere north of the neck. What exactly turns on knowing how far north? It belongs to understanding how the engine in your auto works that the functioning of its carburetor is to aerate the petrol; that’s part of the story about how the engine’s parts contribute to its running right. But why (unless you’re thinking of having it taken out) does it matter where in the engine the carburetor is? What part of how your engine works have you failed to understand if you don’t know that?³

What, indeed, has a philosopher or an art critic failed to understand about our aesthetic appreciation of a Picasso if she doesn’t know, for example, that the colors and shapes on the canvas are processed in distinct areas of the brain? Of course, there are many things about our aesthetic responses to artworks that philosophers and art critics still don’t understand. However, knowledge of where and how some specific elements of our aesthetic responses are implemented in the brain is unlikely to give us a fuller understanding of what these

responses actually are.

This kind of reasoning, however, misrepresents the goal of neuroscientific research, and not just in the case of neuroaesthetics, but cognitive neuroscience in general. It is certainly true that a great deal of research in cognitive neuroscience is concerned with the mapping of perceptual and cognitive functions in the brain, but it would be a mistake to see this as the primary goal of this research.

Part of the problem has to do with the way neuroimaging findings are reported, especially in the media. Major newspapers and popular scientific publications often report that scientists have identified the “neural correlates” of a particular cognitive function X (e.g., face recognition, speech versus music perception, the belief in God), and that this finding may have implications for our understanding of X. Science reporters (and their readers) tend to prefer pretty images of colored brains to more detailed analyses of the data. It is therefore not surprising that many readers come to the conclusion that neuroimaging experiments are primarily concerned with localizing X in the brain as opposed to explaining and defining X. This is unfortunate, as neuroimaging data often suggest new ways of understanding particular cognitive functions.

To illustrate this point, consider the recent proposal by David Freedberg and Vittorio Gallese that sensorimotor processes, in the form of action simulations, may be an essential element of our aesthetic responses to visual artworks (paintings, drawings, sculptures).⁴ Their proposal capitalizes on the discovery of the mirror-neuron system, the set of brain areas that contain neurons that fire both when someone performs an action (e.g., reaching for a cup) and when the same person observes the same action performed by someone else. Just like in the case of action observation (dynamic case), the idea is that one could hypothesize that the mirror-neuron system would be activated when someone observes the depiction of actions in a painting or sculpture (static case). Building on this, they further hypothesize (more surprisingly perhaps) that the mirror-neuron system might also be activated in response to non-figurative works in which the various marks left by the artist’s handling of the artistic medium (e.g., brush strokes) can be related to the implicit artistic movements that went into the production of the work.

Both hypotheses have now received some level of empirical support from various neuroimaging studies,⁵ which suggests that in aesthetic perception, “our brains can reconstruct actions by merely observing the static graphic outcome of an agent’s past action.”

Moreover, these findings demonstrate how neuroimaging data can contribute to a deeper understanding of our aesthetic engagement with artworks. Notice here that the empirical investigation of the sensorimotor dimension of aesthetic perception relies on previous knowledge of the localization of brain function—in this case it relies on the identification of the mirror-neuron system—and that it is on the basis of that knowledge that the hypotheses can be tested. It is therefore clear from this example that the utility of neuroimaging data is not limited to knowing where and how this component of aesthetic response is implemented in the brain. Such data may in fact help answer important questions about the extent to which the sensorimotor dimension is involved in aesthetic perception, such as the specific manner in which it contributes to aesthetic response, or whether it is a necessary element in certain forms of aesthetic perception,

and if so, to what extent is aesthetic appreciation dependent on sensorimotor expertise (e.g., in artists).

Recent findings in the psychology of music perception provide another example of how empirical research may help advance the understanding of how we engage aesthetically with artworks.⁶ The studies, which use audio-visual recordings of professional musicians playing short compositions as stimuli, show that visual information combines with auditory information in the perception of musical expression. In one study, for example, Jane Davidson found that vision contributes to the perception of expressive intensity in both violin and piano performances, and perhaps more surprisingly, that the visual component of the stimuli better indicated expressiveness than the auditory component. In another study, Bradley Vines and his collaborators measured the emotion conveyed by two professional clarinetists playing a Stravinsky composition for solo clarinet.⁷ Musically trained subjects presented with the performance rated how strongly they perceived the expression of nineteen emotions in four groups—active positive, active negative, passive positive, and passive negative. The researchers found that for at least one group, the active positive, visual experience was the primary channel through which variation in the clarinetists' performance intentions was conveyed to the observers.

What these findings suggest, in sum, is that the expressive properties of music are a function of both the sounds of a musical performance and the visual movements of the performers. Dominic Lopes and I have argued that this forces us to consider the possibility that music's expressive properties (e.g., its sadness) may be visual as well as sonic.⁸ Or more precisely, if music expresses what we think it does, then its expressive properties may be visual as well as sonic. The alternative appears less interesting: if music's expressive properties are purely sonic, then it expresses less than we think it does.

What, then, can we conclude from these two examples of research in the aesthetic sciences? Perhaps they show that when it comes to research on aesthetic response, a collaboration between the different scientific and humanistic studies should not be a division of labor wherein researchers in the humanities define the nature of aesthetic response, leaving scientists to discover the mechanisms by which it is realized. They suggest, in fact, that the aesthetic sciences should take an integral part, along with philosophers, art critics and historians, in the development of a richer and fuller understanding of our aesthetic engagement with artworks.

Endnotes

1. See T. Jacobsen, "Bridging the Arts and Sciences: a Framework for the Psychology of Aesthetics," *Leonardo*, 39(2), 2006, 155-162 for a brief overview of the literature.
2. R. Reber, "Art in Its Experience: Can Empirical Psychology Help Assess Artistic Value?" *Leonardo* 41 (4), 2008, 367-72, p. 367.
3. J. Fodor, "Let your Brain Alone," *London Review of Books*, 21(19), 1999.
4. D. Freedberg and V. Gallese, "Motion, Emotion and Empathy in Aesthetic Experience," *Trends in Cognitive Science*, 11(5), 2007, 197-203.
5. For a review of this literature see C. Di Dio and V. Gallese, "Neuroaesthetics: a Review," *Current Opinion in Neurobiology*, 19, 2009, 682-87.
6. J. Davidson, "Visual Perception of Performance Manner in the

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7. Vines et al., “Dimensions of Emotion in Expressive Musical Performance.”
8. V. Bergeron and D. Lopes, “Hearing and Seeing Musical Expression,”
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